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SILICON CHIP

OCTOBER 1997
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5-Digit Tachometer

Have Disc, Will Travel

Slide-out carrier makes it easy to remove & transport hard disc drives

Building the 500W Audio Amplifier

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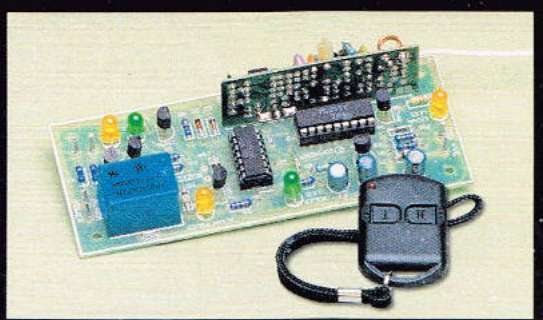
PC-CONTROLLED 6-CHANNEL VOLTMETER

FLICKERING FLAME: A SIMPLE LIGHT SHOW



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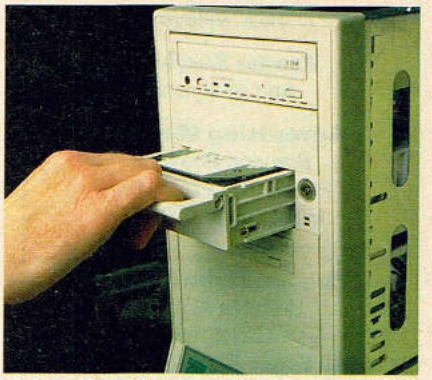

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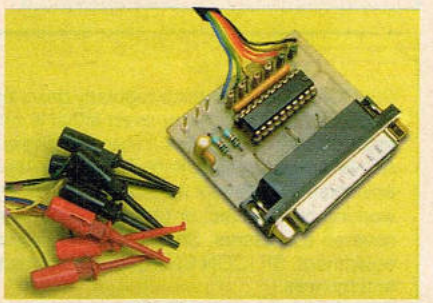

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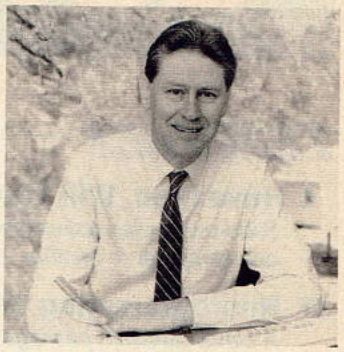
PUBLISHER'S LETTER

Corrosion problems can be minimised



Ever thought about corrosion and how much it costs you each year? Most people, when they think about corrosion, think about rust in their car and that is serious enough. After all, rust is the main reason why most cars are finally pensioned off, at least in those Australian states where annual registration inspections are required.

But I am thinking of the problem of corrosion in electronic and electrical installations. Perhaps the most glaring of these are involved in domestic TV antenna installations. At one time, a TV antenna installation could be expected to last 20 years or more but with more people doing their own installations, the antenna life might only be a few years and that amounts to a big waste of time and money.

A large part of the problem now is that fixtures and fittings which used to be hot dip galvanised are now very lightly zinc plated or worse, cadmium plated and passivated. Steel fittings that are zinc plated have a blue-white shiny appearance while those that a cad-plated and passivated have a yellowy golden appearance.

Now while cadmium plated and passivated steel may be OK for the chassis of electrical equipment used indoors it is pretty useless outdoors. In coastal areas and areas with industrial fallout, such fittings will rust heavily within 12 months. Bright zinc plated fittings are not much better.

The same can be said of screws, bolts and nuts which are zinc plated - they rust out quickly.

This tendency to install cheap metal fittings is now very widespread, partly because many stores, particularly hardware stores and supermarkets, only stock the cheap rubbish. Have a look around your own home and where you work and note how many of the metal fixtures and fittings are rusting or corroded. You might be quite surprised at how things are deteriorating right before your eyes. Anodised or powder-coated aluminium fittings also often fare poorly in coastal districts and areas of high fallout and are also to be avoided.

In the long run, it is much better to use steel fittings which are hot dip galvanised. And if you live within say, two or three kilometres of the coast, use only stainless steel. Stainless steel hardware is a lot more expensive but you will never have to replace it. When you consider how much corrosion there is in all the buildings across Australia, the cost runs into billions of dollars each year. With a little thought and slight extra initial cost, much of this can be avoided.

Leo Simpson

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

Advertisers are warned that they are responsible for the content of all advertisements and that they must conform to the Trade Practices Act 1974 or as subsequently amended and to any governmental regulations which are applicable.

COLOUR MONITOR NEW
New 12V DC-1A 6" colour monitor, no case, just the tube and driver PCBs, RGB inputs (some info might be available): **$65**

SUPER BRIGHT BLUE LEDS
BY FAR THE BRIGHTEST BLUE EVER OFFERED, super bright at 400mCd: **$1.50** ea or **10 for $10**

5mm LEDS AT SUPER PRICES
- 1Cd red: **10 for $4**
- 300mCd green: **$1.10** ea. or **10 for $7** (*make white light by mixing the output of red green and blue*)
- 3Cd red: **$1.10** ea. or **10 for $7**
- 3Cd yellow (small torch!) also available in 3mm: **10 for $9**
- Super bright flashing LEDs: **$1.50** ea. or **10 for $10**

NEW semiconductors
- CA3140 — MOSFET I/P opamp: **5 for $5**
- TL494 — switchmode power supply IC: **5 for $5**
- NE555 — timer IC: **10 for $5**
- ICL7106 — LCD display driver: **$5**
- CL7107 — LED display driver: **$5**
- IRFZ44 MOSFETS: 60V, 0.028 ohm on-resistance, 50A: **10 for $3**
- C8050 & C8550 transistor **20** for **$5**

NEW **CALLER ID**
See the phone number of your incoming calls on an LCD screen while the phone is ringing. Has 80 call memory, dialler etc. Approved units should be available in October. Around $50!

110V AC FANS
New 4" fans: **$8**

PIC IC PROGRAMMER
Ready made, coming soon, email or fax for more information: **$49**

CHARACTER DISPLAYS
Back in stock late this month! Standard 32 x 4 character displays using Hitachi ICs. **ON SPECIAL: $18**

CCD IMAGE SENSOR NEW
High quality "Thomson" brand, 576x550 pixels with antiblooming, with full data but no circuit suggestions, usable response from 400 to 1100nm, 30dB S/N at 40 milli-lux, 2/3" optics compatible format: **$35**

NEW COMPUTER CONTROLLED STEPPER MOTOR KIT
Similar to our previous stepper motor kit but with improvements so larger motors can be driven more efficiently, with much reduced loading on the computer's parallel port, and 2.5KV opto-isolation between the stepper driving circuit and the computer. Previous purchasers: contact us for a simple modification to greatly reduce the loading on the computer's parallel port. PCB and all on board components kit plus software and information: **$39** or with two M35 motors: **$49**

MINI TV STATION
Make your own mini TV station with this metal cased, commercial transmitter with telescopic antenna. Dimensions 123 x 70 x 20mm, 12V operation. Includes power switch, indicator LED, RCA audio and video connectors, twin RCA-RCA lead. Our 32mm AUDIO PREAMPLIFIER kit with electret microphone (**$8**), and a CCD camera completes the station. Transmitter: **$30.** When purchased with a CCD camera **$20**. Regulated 10.4V-500mA plugpack to suit: **$10**

12V - 2.5W SOLAR PANEL KIT
Amorphous solar panel and glass backing: **SPECIAL $20** ea, **4** for **$60**

BEST VALUE CCD CAMERA
The best "value for money" CCD camera on the market! See us for a comparison to advertised cheaper models! We do not need to make you BEWARE! Tiny CCD camera, 0.1 lux, IR responsive, high resolution. This camera has a metal lens housing (not plastic) and performs better than many cheaper models. No surcharge for credit card orders! A pinhole lens version also available for the same price: $120 Yes, that's for just one camera and you don't need to be in a plan costing you thousands of dollars for quantity discounts: Just ring!! SALES TAX EXEMPT PRICE FOR EITHER CAMERA: **$99**. For different lenses, ring us!
Coming: A **lower priced** high quality standard or pinhole CCD camera. Quality product for under **$100**. Fax/ring or email for more info.

COLOUR CCD CAMERA - NEW
This high quality CCD camera is built over 3 boards which are joined with a flexible cable that can be folded into a very compact camera. Head board: 42x20.5mm, lens height: 24mm. Main board: 42x42x9mm. Power board 42x20.5x8.8mm. ***SPECIAL Introductory price:*** **$350**, less with sales tax exemption.

KITS FOR CCD CAMERA SECURITY
New INTERFACE KIT FOR TIME LAPSE RECORDING: now has relay contact outputs! Can be directly connected to a VCR or via a learning remote control: **$25** for PCB and all on-board components, used PIR to suit: **$12**.
- **32mm 10 LED IR ILLUMINATOR** new IR (880nm) LEDs have an output about equal to our old 42 LED IR illuminator: **$14.**
- **32mm AUDIO PREAMPLIFIER** An **$8** kit that produces a 'line level' signal from an electret microphone, connect the output to our:
- **UHF VIDEO TRANSMITTER** (**$30**) or **$20** when bought with the camera. for a complete Audio-Video link.

32mm AUDIO AMPLIFIER: An LM380 based **$9** audio power amplifier which can directly drive a speaker — needs the 32mm preamplifier. *WHAT IS 32mm?* All boards are 32mm dia, so you can house these kits in a plastic 32mm joiner: cheap plumbing part.

FAX POLLING
Back by popular demand. Poll (02) 9570 7910 and (02) 9579 4985. Updated monthly.

BARGAIN ARGON LASER HEADS
Cheapest way to get a BLUE-GREEN LASER beam! These used argons have around 30mW output (may need a licence), 6 mth guarantee. Power supply based on a transformer with 80V @ 2A and 3V @ 20A secondaries. Ring or email for more info. Head only: **$250.**

NEW **LASER ENGINE**
Brand new complete laser engine as used in laser printers. Includes a polygon scanner motor with xtal controlled driver PCB, 5mW/780nm laser diode in collimated housing mirrors/mirrors lenses etc. Information on making motor and laser operational included. Bargain at **$35**

5mW/650nm LASER POINTER KIT
YES, NEW 650nm kit. Very bright! Complete laser pointer that works from 3–4V DC. Includes 650nm/5mW laser diode, new handheld case 125x39x25mm, adjustable collimator lens, PCB battery holder: (K35) **$35**

AUDIO - VIDEO MONITOR
2ch compact high res 5" screen B/W audio and video monitor. 12V DC 1A. Monitor and 6-way mini input connector only: **$125**

AMPLIFIER - PREAMP AND MORE
A professional mostly SMD PCB with a 5W amplifier based on a TDA1905 IC, and a separate audio preamp. We also include a prewired high quality unidirectional electret mic with wind filter and mounting clip, a small speaker and hook up info. Probably from a communications system. Great for many applications such as a two way intercom that doesn't require switching (needs 2). Less than the cost of the electret mic. **$15 ea, 2 for $24.**

SOLAR REGULATOR
Ref: EA Nov/Dec 94 (intelligent battery charger). Efficiently charge 12-24V batteries from solar panels, but can also be used with simple car battery chargers to prevent overcharging. Very high efficiency due to MOSFET switch and Shottky diode. 7.5A or 15A kit: **$26/$29** (K09)

MASTHEAD AMPLIFIER KIT
Our famous MAR-6 based masthead amplifier. 2-section PCB (so power supply section can be indoors) and components kit (K03) **$15.** Suitable plugpack (PP2): **$6** Weatherproof box: (HB4) **$2.50**. Box for power supply: (HB1) **$2.50** Rabbit-ears antenna (RF2) **$7** (MAR-6 available separately)

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A new subsidiary company to OATLEY ELECTRONICS, for giving TAX EXEMPT PRICES to entitled organisations. Product range will increase rapidly.
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PC POCKET SAMPLER KIT
Data logger/sampler, computer controlled chart recorder, slow speed scope. Incredible value value **$30**

DISCO LASER LIGHT SHOW PACK
The above 5mW/650nm kit plus our AUTOMATIC LASER LIGHT SHOW: **$99**

650nm LASER POINTER SPECIAL
Light weight 2 x AAA pen-size pointer with 650nm laser, very bright: **$55**

650nm LASER MODULE
Our new module has a 650nm laser diode. Very bright! **$50**

VISIBLE LASER DIODE MODULE KIT - COMING SOON
Same circuit as our "visible laser diode kit" but a smaller PCB (25 x 50mm, WxD) that fits into tubing. 650nm/5mW laser diode, 3V: **$29**

NICAD CHARGER & DISCHARGER
Professional, SMD, switch mode, assembled and tested NICAD battery charger/discharger PCB assembly. For fast-charging 7.2V AA nicads. Basic info provided, plugpack not included. *Bargain:* **$9** ea or **3 for $21**

NICAD BATTERY SPECIAL
New 1.2V-400mAh cells wired in packs of 6. Each pack has a thermal cut out switch, each cell is 16 x 45 x 5mm, as used in mobile phones, 6 packs (30 batteries): **$10**

DIGITAL BAR CODE WANDS NEW
New, US made wands fitted with 2.5m curly cord terminated in a 5-pin 240º DIN plug. Contains an optical sensor, visible red LED, a photo IC detector, and precision aspheric optics. Converts bar codes into a digital pulse train as it's manually swept across the bar code. Uses a sapphire tip, pot size 0.19mm. Open collector TTL/CMOS compatible output, powered from 5V: **$45**

3-STAGE IMAGE INTENSIFIER TUBES
Back in stock. Make a high resolution night scope that works in starlight! Three tubes, the inverter kit and a suitable eyepiece. Housing and front lens not supplied: **$250**

CHARACTER DISPLAYS
Back in stock late this month! Standard 32 x 4 character displays using Hitachi ICs. **SPECIAL: $18**

12V/7Ah GEL BATTERY BARGAIN
Fresh stock 7Ah battery (150 x 95 x 65mm, 2.7kg) and one gel/lead-acid battery charger: **$33**

DC MOTOR SPEED CONTROL-EXPERIMENTERS PACK
NEW One 20A motor speed controller kit (similar to SC - Jun 97) **$18,** plus two small new 12V DC motors (40mm dia, 40mm long) plus one used car windscreen wiper motor (has internal gear reduction) for: **$32**

COMPUTER POWER SUPPLY
NEW New, complete PCB assembly only. Size 45 x 108 x 200mm. Switchable 120/230V AC input. DC outputs: +5V/6A, +12V/1A, -12V/1A, -5V/1A. Circuit provided, RU approval. Modern design. Mains input - not for the inexperienced! Be quick: **$16 ea** or **4 for $56**

VERY EFFICIENT WHITE LIGHT - LCD DISPLAY NEW
Brand new "second grade" (few missing pixels) Sharp 640x480 LCD display (LM64P722) with a very efficient "state of the art" cold cathode BL fluorescent lamp (5mm dia, 150mm long) which is very easy to remove! Produces useful white light at about 1-3W AC input! Lamp has a 10,000hr life! Removing the display reveals a uniformly lit 150 x 200mm backplane. Complete display plus BL inverter kit (needs 12V/150mA): **$15** Data sheets (11 pages) for a similar display: **$2**

12V GEL BATTERY BARGAIN
Guaranteed Panasonic '94 date code 12V gel batteries! New, 2.3Ahr, 180 x 80 x 22mm, 0.67kg, as used in video equipment etc. **$10 ea**. That's a bargain but! **Two** batteries and an SLA charger: **$25!**

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Have Disc,

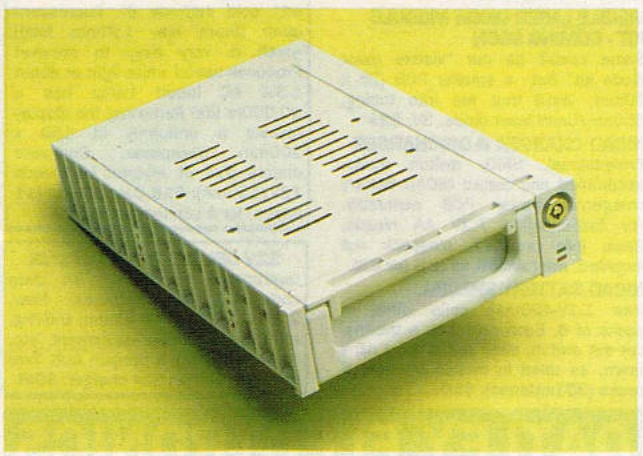
Do you have an old hard disc drive lying in a cupboard somewhere, unused and unloved? Here's a way to put it to good use for next to nothing and perhaps give you the flexibility you've always dreamed about!

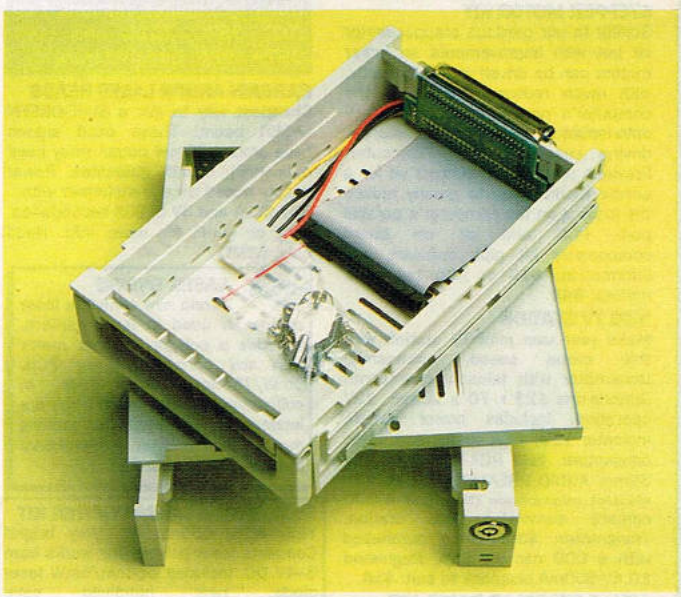
By ROSS TESTER

A RECENT JAYCAR advertisement in SILICON CHIP caught our eye because it appeared that it might solve a couple of problems we were having transporting very large files between two remote computers. And it did!

But first, our problem. As you probably realise, SILICON CHIP and its sister magazine ZOOM are produced entirely on computer. The first time the printer sees any part of these magazines is as finished computer files. Unfortunately, those files, particularly a colour page, can easily be fifty megabytes (50Mb) or more.

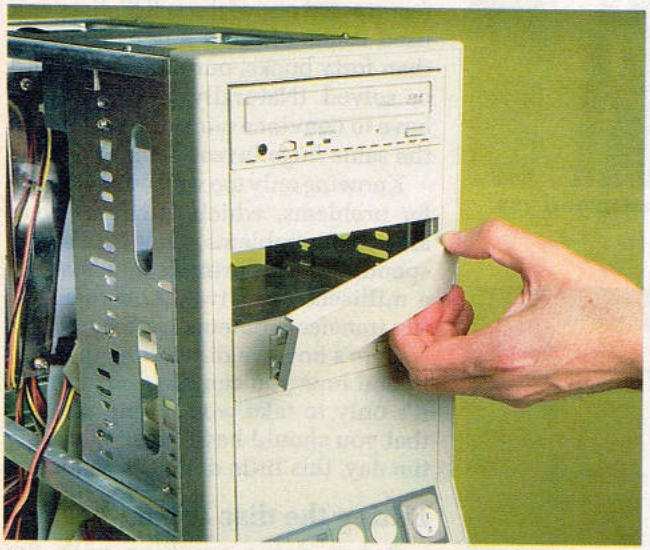
We have used a number of methods to transport these files to the printers. We've "modemed" them (is there such a word?) but that's really only feasible for relatively small files – large files simply take too much time. The most usual method is to copy the files to 88Mb Syquest discs and to send these to the printer. However, after years of faithful service our Syquest drive was starting to become less than 100% reliable and, in any case, 88Mb is no longer really big enough. It needed replacement.



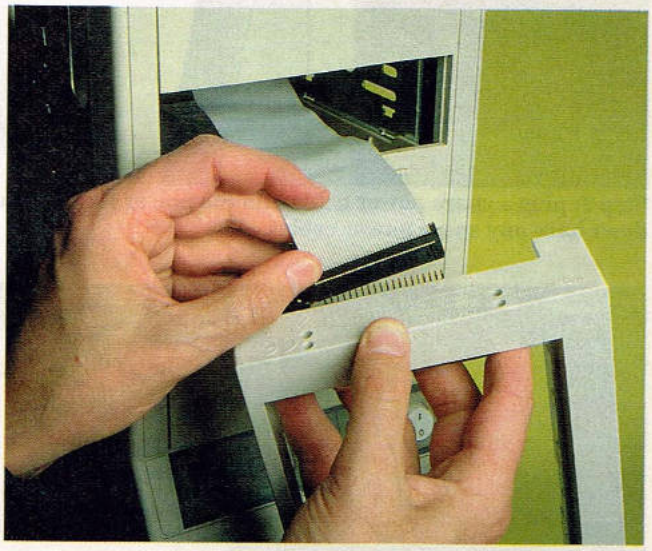


The "Mobile Rack" comes in two versions, one for IDE drives and the other for SCSI drives. It's just the shot for transferring large amounts of data from one computer to another, or for taking a backup copy of valuable office data home with you at night.

Will Travel



Step 1: remove the faceplate covering a spare drive bay.



Step 2: plug the data cable into the socket on the frame.

But which way to go? Take a look at a typical computer products catalog and you'll see that a myriad of portable storage devices is now available. Along with Syquest drives (themselves now available in at least four different configurations), there are high capacity floppies, magneto-optical drives, Zip drives, Jaz drives, Syjet drives and recordable CD-ROM drives (some now re-writable) – to name but a few. Would you believe that there's even one called a Shark?

Each has its own advantages and disadvantages. We'll look at a few.

Zip drives are now quite popular. The discs are cheap but they only hold 100Mb – not much more than our old Syquest discs. The Jaz drive, the Zip's "big brother", is much better in this regard – up to a gigabyte per disc. However, the drives and discs are still relatively expensive and not, as yet, particularly common. And of course, both Zip and Jaz discs (like Syquests) can be erased by stray magnetic fields – so that's a negative.

High capacity (120Mb) floppy disc drives are now available. Backward-compatible with the old faithful but now-almost-useless 3.5-inch floppy disc, they will probably catch on but as yet they're almost unheard of. They're also pretty expensive (about $350 for the drive and $70 for the discs compared to about $40-$50 for a 1.44Mb floppy drive and cents for the discs!).

Magneto-optical drives looked like a pretty good bet for a while. Robust and unaffected by magnetic fields, the discs hold up to 640Mb but they are also expensive and much less common than most other storage devices. Alas, we bought an MO drive some time ago but very few others did. It's an orphan!

How about CD-ROM – both the recordable variety and the new re-recordable units?

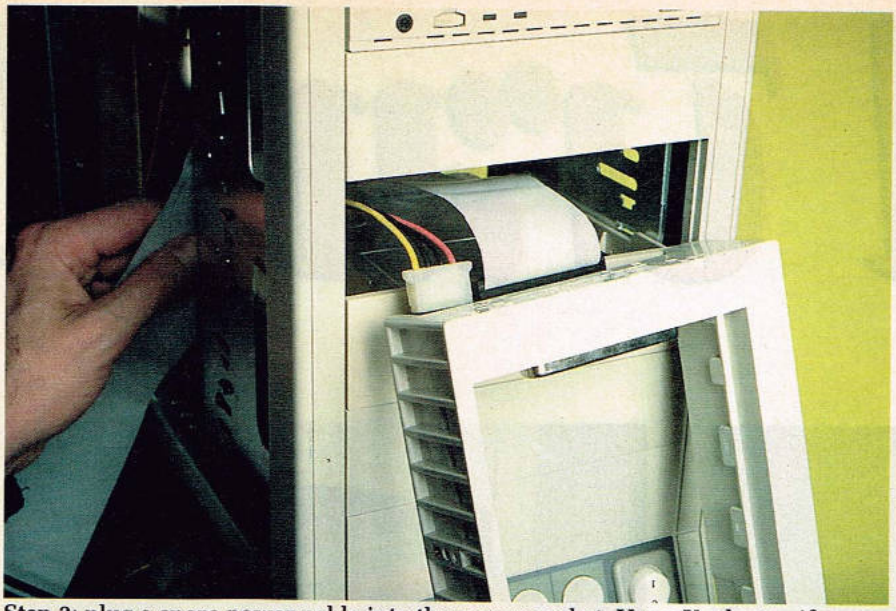
Yes, they're very attractively priced (the drives and the CDs themselves have dropped dramatically in price in the past year, perhaps due to supply and demand but just as likely because a new standard – DVD – has arrived). Of course, there is no problem in anyone else reading a CD because just about every PC made in the last couple of years has a CD-ROM drive built in. CDs are also quite robust and unaffected by magnetic fields.

We also purchased a CD-ROM writer and have used this very successfully. The one big drawback is time: you can't easily add files to a CD-ROM as you can, say, to a hard disc or a Syquest disc. And where large amounts of data are involved, it can take more than an hour to test, write and verify the CD. Sometimes that's an hour we can't spare when the presses are waiting!

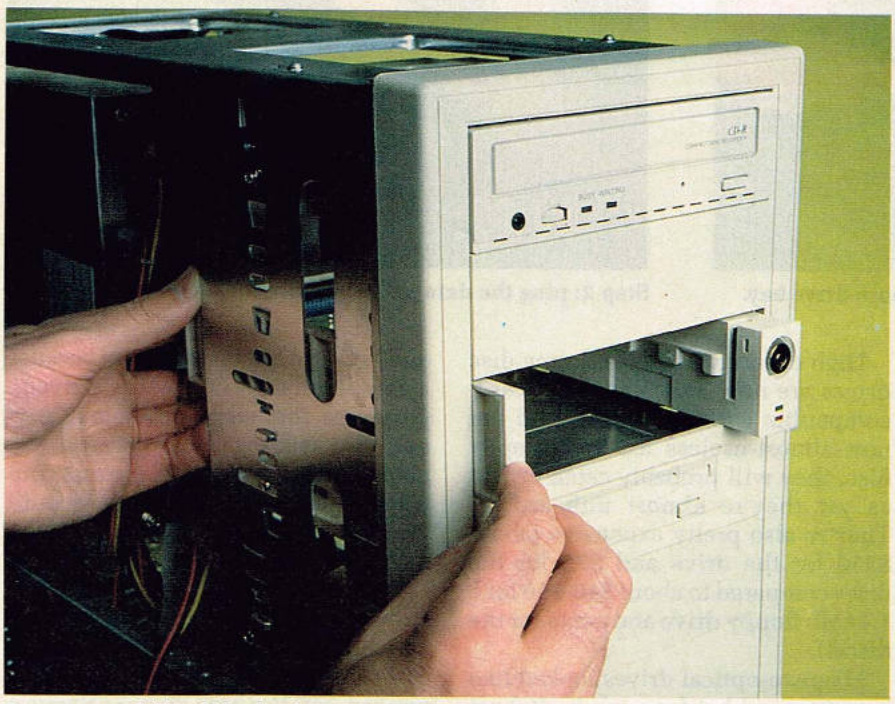
So you can see, the decision is not at all simple. Or at least it wasn't until we spotted a rather interesting item in the aforementioned Jaycar advert.

Mobile rack

The item advertised was a "Mobile Rack", or removable hard disc carrier and frame for $39.95. As the name



Step 3: plug a spare power cable into the power socket. Use a Y-adaptor if you don't have any spare power cables.



Step 4: carefully slide the frame into the drive bay.

suggests, the device is designed to allow any standard size 3.5-inch or 2.5-inch disc drive (half height or less), which would normally be mounted inside a computer, to be made removable. The frame comes in two types, one to suit standard IDE hard disc drives and the other to suit SCSI drives.

There are two very obvious uses for such a device. The first is file security and we'll have more to say on this a little later. The second is to allow the computer's hard disc drive to be transported from one computer to another, allowing files, programs and so on to be transported. Aha! Exactly what we were looking for!

But did we really have to use one of the hard disc drives in our computers? Why not another one altogether?

Like most computer users, we have upgraded our hard disc drives many times as our needs increased (no, make that read as the programs we use demanded!). What was a perfectly good hard disc drive a couple of years ago, with a capacity of 100Mb or 200Mb, has become today's paperweight.

A quick search soon turned up a couple of old IDE hard discs sitting in the bottom drawer of a filing cabinet (mainly 'cos no-one had the heart to throw out a perfectly good hard disc! But then again, I still have my first-ever 20Mb MFM drive in a cupboard at home. Call me a sentimentalist if you will).

Anyway, we reasoned, what if we resurrected one of these IDE discs and used it one of these frames? For less than forty bucks, our problems could be solved. (Naturally, we would also have to convince our printers to make the same huge investment).

Knowing only too well our file transfer problems, which of course were also their problems, they baulked at spending such a princely sum for only a millisecond or two. And then our file transfer problems were over!

Here's how we did it, how they did it, and how you can do it too. Even if it's only to take work home at night that you should have finished during the day, this little device is a gem!

Fitting the disc drive

Before doing anything with the drawer, have a good look at your disc drive. Make a note of its type number and any information printed on it – especially such information as its size and the number of cylinders, heads, sectors, landing zones, precompression and so on.

If this information isn't printed on your drive (and on many older drives it may not be), you will need to find it out – either from the manufacturer's data sheet which came with the drive, from the distributor, a friendly computer techie (who will probably have one of those handy programs which list hard disc drive parameters) or – if you have access to it - the manufacturer's web site on the Internet. And while you're about it, you will also need to find out about the various jumper settings that are applicable to the drive.

The jumpers are normally changed by moving a small header onto various sets of pins. These may be mounted on the disc drive PC board itself or they may be elsewhere on the drive.

You may or may not need to change a jumper: if this is the only drive in

your computer and you are simply making it portable, you won't have to bother. It would have been set as a "master" – keep it that way.

However, if you are adding another IDE drive to your computer, it will probably need to be set as a "slave". Each drive brand and even types within a brand differ in the way this is done.

Finally, if fitting a SCSI drive, you really do need to refer to the manufacturer's data for the correct settings (see separate panel).

Once the jumpers are selected or checked, put the drive aside for a moment.

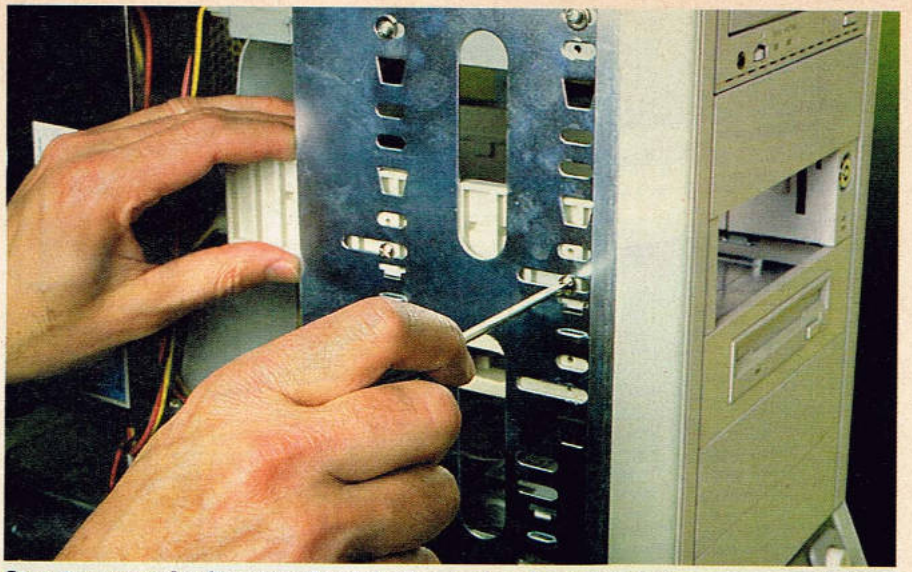
Slide the drawer from the frame and remove its top and bottom metal covers. At first glance, there appears to be no easy way to do this because there are no screws but all you have to do is gently prise the cover off the drawer (even a fingernail will do it).

Inside the drawer, you will find a little bag of screws, the front lock keys and a bag of silica gel which says "do not eat" (so don't – but remember to dispose of it where the littlies won't get at it either!). You will also see two cables – a flat ribbon data cable and a 4-pin power cable. In 99.9% of circumstances, they are the only connections needed.

Connect the cables to the drive before placing the drive into the drawer – it's much easier. You will note a red stripe along one edge of the data cable – this is pin 1 (usually, but not always, marked on the disc drive PC board). In nearly all cases, the drive will mount the right way up (ie, PC board to the bottom), with the data cable the right way around.

Next, fit the power cable. It is usual for the red lead of the power cable to be closest to the red lead of the data cable; in any case, the plug and socket are keyed which make getting it the wrong way around quite difficult. (Note that we said difficult, not impossible: forcing the cable in the wrong way around will have a briefly spectacular effect as your drive makes its way to hard disc heaven with a puff of smoke and that rather horrible smell of money burning!).

Now ease your hard disc drive into the drawer. Older style half height drives are a tight fit, newer low profile drives are easier. Move the drive backwards and forwards until its mounting holes line up with the mounting holes in the drawer. Using the screws supplied secure the drive to the drawer.



Step 5: secure the frame in the drive bay using the mounting screws supplied.

Finally, pop the top and bottom covers back on – and that part is finished.

Mounting the carrier frame

This step is virtually identical to fitting a standard hard disc drive to a PC. If you haven't done that before, the steps are as follows (obviously we don't have to tell you to turn off your computer and remove its cover!):

- Select a suitable drive bay. It will need to accept a standard 5-25-inch half-height disc drive and it will need to be close enough to the first, or master, disc drive to connect to the second socket on the data cable. If you find your data cable has only one socket, you're up for a new data cable. Don't worry, they're cheap! Also note that either socket can be used for either hard disc drive, so if you have to swap the connector over to make it reach, no problem.
- Remove the faceplate covering the chosen drive bay. This faceplate is

Should you use an old hard disc drive?

WHILE WE HAVE talked about resurrecting an old drive, there are a few points to keep in mind.

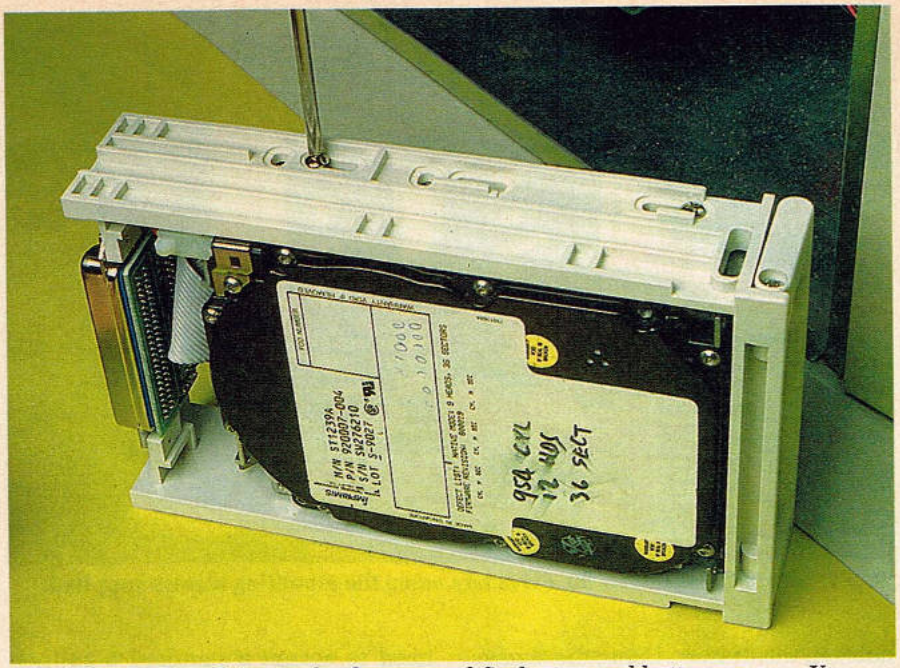
Old drives are quite possibly poorer performers than today's drives, so you might find that disc-intensive tasks take a little longer to do. However, we don't see that as too much of a problem.

We've already mentioned possible incompatibility problems. That's for you to discover all for yourself (lucky you!).

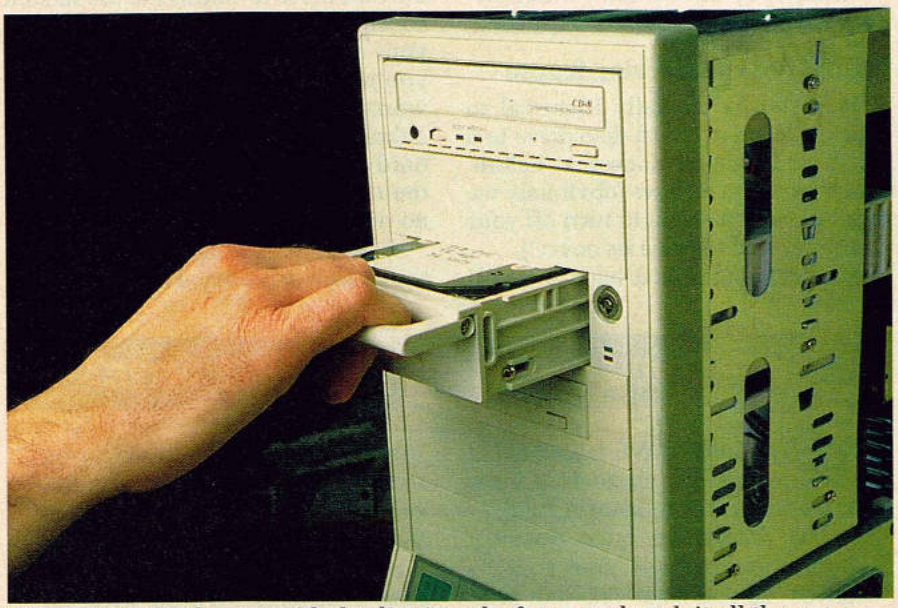
The area of most concern is that the drive might be worn out (or close to it). With the price of hard discs today a tiny fraction of what they were a few years ago, you might find that it is a lesser risk to invest in a new drive, particularly if important information is to be stored on it. There are some real bargain drives around – one or two gigabyte drives for just a couple of hundred dollars or so!

Having said that, there is still a case for using an old drive. If it spins up properly when it's turned on (ie, the bearings aren't shot), if it doesn't report loads of bad sectors, if it doesn't make a ghastly scratching sound when you turn it on or off (ie, the heads aren't contacting the disc surface), and if you can run Scandisk or Checkdisk and get a clean bill of health after the full surface scan, then go ahead and use it.

Perhaps, though, there is even more of a case for updating your current drive to a new higher-capacity model and using the old one as the transportable!



Step 6: fit the disc drive to the drawer and fit the top and bottom covers. You can leave the covers off if they foul the drive – see text.



Step 7: slide the drawer with the disc into the frame and push it all the way home so that it mates with the socket on the carrier.

usually plastic (occasionally metal) and either pops out or has screws holding it in place. Sometimes, though, there is a metal plate which needs to be unscrewed or broken away from the main case (the latter is occasionally used on "tower" cases which have a separate, removable front panel).

• Check to see if you have a spare power cable fitted with a large 4-pin white plastic plug. If you don't, you will need to buy a "Y" adaptor – a power cable with a socket and two plugs. These are readily available but prices vary enormously. We normally pay about $5 for these but some stores have asked us, unsuccessfully of course, for $24.95 each! To fit this, simply remove the same type of power plug from some other device (eg, a floppy drive), plug this into the Y adaptor socket and push one of the plugs back into the device you just took it from. The other plug, naturally, goes to the mobile rack frame.

• Carefully push the data cable socket onto its mating plug on the frame. Remember that the red stripe goes to pin 1 (clearly marked on the back of the frame). Check that you have the socket correctly mated otherwise the drive won't work.

• Now it's time to slide the frame into its correct position in the drive bay, so that the front of the frame is flush with the front of the computer case or with other drives. Most drive bays have long slots in them to allow you to accurately position the frame. Install two screws on each side to hold it in place and nip the screws up firmly. It is important that you don't skimp on the screws here because the sides of the frame need to be held rigidly in position so that the drawer slides in and out properly.

If your drive bay is the type that uses sliders which clip into place (as on one of our computers), you have no choice but to use them but these can cause a bit of a problem. The pressure of the spring clips causes the edges of the frame to flex inwards, making it difficult to fit the drawer. However, the drawer will slide in with a little jiggling and juggling!

• Slide the drawer containing the disc drive into the bay to check that it fits correctly. If you find that it is too tight a fit, perhaps because you are using an older drive which is a tight fit in the drawer, it is perfectly acceptable to use the drive without its top and bottom covers. You might be sacrificing a little disc protection when it is outside the computer but you will save the vertical space. The drive would probably be happier working without covers anyway – it would stay cooler, although the covers are well ventilated.

• Make a final check to ensure you haven't dislodged any other cables – it's very easy to do, particularly when working in confined spaces and especially so with easily removed cables such as on floppy drives.

Setting up the drive

If you are simply making the only drive in your machine removable then you won't have any setting-up to do, because electrically nothing's changed. But if you're adding another drive, as we did, it's a slightly different story. And it also depends on the age of your computer.

On a modern computer with a

"Plug'n'Play" BIOS and Windows 95, you may find that the disc is auto detected when you turn the computer on. Watch the screen carefully before the Windows 95 sign-on screen appears.

Even if that doesn't work, many new computers have an option in the CMOS Setup to auto detect hard discs (see below). Try it!

On an older computer (eg, a 486 or older), you're going to have to tell it that you've changed the disc by going into the CMOS setup just after you turn the machine on. With most machines, you will probably get a message such as "Press DEL to enter setup" not too long after the machine is turned on.

Even older machines such as 386s and earlier (what – you're still using one?) were not quite so standardised. Watch the screen or refer to your manual to see which keys you need to press to enter setup. Control +, Alt +, Control Escape and Alt Escape were often used but there were others!

When you enter Setup you are usually presented with a range of options. The one you want is typically the first one: "Standard CMOS Setup". Press enter and next you will see a warning screen threatening you with mortal injuries if you dare to make any adjustments. Ignore it!

The next screen shows you what the computer believes is fitted – for example, a 3.5-inch "A" drive, a 5.5-inch "B" drive and a 980Mb "C" drive (hard disc) but with nothing listed for hard drive "D" (the new removable drive). You must manually change the "D" drive parameters to that of the hard disc you've just fitted. Where do you get those parameters? That's why we had you write them down before!

Note that the arrow keys get you to where you want on the screen, while page up and page down modify the parameters. You will need to change drive "D" to a type 47, the option which allows you to manually enter parameters.

Enter the parameters asked for, except for the size. Setup works this out for you and you should check this to confirm that you listed everything else correctly. This done, follow any instructions on the screen to leave the setup area (you typically press the "Escape" key) and return to the opening CMOS setup screen. This time, select the option which writes the setup to CMOS memory (probably something like "Write to CMOS and exit").

You will need to reboot the computer for the changes to take effect. Once done, check to see that everything works as intended. (If you enter the CMOS setup again, just for a "look-see", you should find that "D" drive is now listed. You can then exit the CMOS setup without changing anything by selecting the "Do Not Write to CMOS and Exit" option. It sounds like double dutch but that's the one you want).

What if it doesn't work?

Woops! Something's wrong – an er-

SCSI – What Does It Mean?

SCSI (pronounced as "scuzzi") stands for Small Computer Systems Interface and is a very popular method of connecting peripherals to a PC. Apart from its speed (the latest SCSI disc drives are very fast), it has the advantage of being device independent – you can connect up to seven SCSI devices on the one cable without having to worry about what those devices are.

You could have a scanner, tape backup, a hard disc or two, CD-ROM reader or writer and so on in the chain. As long as each device has its own unique identification, the system can cope with it. The devices can be internal or external and are simply "daisy chained" from one to the next.

External devices have the luxury of being removable. As long as the cabling is properly terminated at either end, you can remove SCSI devices from the system at will.

One advantage SCSI drives have over standard (IDE) drives is that it is very easy to assign new drive letters to the drives, particularly under Windows 95 and Windows NT. If you have a Plug'n'Play BIOS , your PC won't tie itself in knots when you remove an IDE drive. However, it can be mentally flexing, to say the least, to try to remember what drive is what because the operating system automatically assigns the next letter of the alphabet to the next drive it finds.

With SCSI drives, though, you can change the drive letter to any letter of the alphabet (except, of course, those already is use). If you make your SCSI disc drive "X", for example, it will stay drive X.

You set the drive letter through the Control Panel. To do this, double-click System, select Device Manager, click on the hard disc you want to change and check the "removable drive" box. The system will now allow you to change the drive letter by entering the same (wanted) drive letter in the start and end reserved drive letter boxes. When you reboot, the drive will have that drive letter.

That's one of the advantages. The downside is that most SCSI devices, especially hard disc drives, are significantly more expensive than equivalent IDE drives.

One point to note about SCSI is that it requires proper termination: the devices on the ends of the chain need to be terminated, either physically with a terminator or via a DIP switch on the device PC board (some devices may use software termination). If they aren't terminated, operation is at best unreliable (usually it won't work at all) and if the wrong devices are terminated, those following on the chain have little chance of working.

Just remember that the SCSI controller card is itself a SCSI device and if it is at the end of the SCSI cable (eg, if you have *all* internal or *all* external SCSI devices), it must be terminated just like the SCSI device at the other end of the cable. If you have a mixture of internal and external SCSI devices, the card is simply another SCSI device on the cable and must not be terminated.

SCSI devices have a reputation (only partially deserved) for requiring more setting up than, say, IDE disc drives. Typically, a SCSI controller card needs to be fitted and drivers loaded to run that card. Once installed, though, a SCSI system is very reliable and easy to use.

How Many Drives Can you Fit?

ON OLDER (most 486 or earlier) machines, only two IDE drives can be fitted – one as a primary, the other as a slave.

If your computer is a modern type (ie, Pentium or equivalent), you can normally run up to four IDE hard discs. Two can be run in the normal "master/slave" arrangement we have talked about here on the "Primary IDE Port" and another two can be similarly run on the "Secondary IDE Port".

On a Pentium, the portable drive could be fitted as either the Primary Master (if it is the only drive) or, assuming a two drive system, the Primary Slave OR the Secondary Master. Note that most CD-ROM drives these days are also an IDE device and may take the place of a hard disc drive. They are jumpered as master or slave in exactly the same way as a hard disc.

If you have an older machine and wish to run two disc drives and a CD-ROM drive, the easiest way to do it is to buy a sound card with an IDE CD-ROM driver. They cost very little (from about $50) and give you sound capability as well as freeing up one of your IDE ports.

ror message such as "HDD or controller failure" usually means that the parameters are incorrect or that the cable or jumper is wrong. Try going back into the CMOS Setup and telling the computer you *don't* have a "D" drive and see if that removes the error message. If it does, you have a problem with the drive. Check its connections or jumpers and if these are OK, check the drive parameters.

If you don't get any joy, tell CMOS you have *no* hard disc drives and try booting from a bootable floppy - just to start eliminating possibilities. You might have accidentally dislodged the floppy disc cable for example, or replaced the cable incorrectly if you had to temporarily remove it.

If your computer used to work with one hard disc but now doesn't work with two, restore it to what it was (ie, disconnect the new drive) and try booting again. If it doesn't work, the chances are pretty good that you have dislodged a cable.

Go back over all the cables and the changes you've made – a common fault is when power cables are not pushed in far enough, especially a plug and socket (eg, the "Y" adaptor). Systematically eliminate possibilities and you should find the fault.

If a known good drive simply refuses to work, you could have incompatibility problems. This mainly occurs with older drives. There have been many cases when a drive will not work with a certain model (or models) of another brand and yet will work with other models or brands.

In some cases, a drive combination might not work on one computer but the same setup will work fine on another computer. Fortunately, disc drive incompatibilites are fairly rare these days but it can occasionally be a problem if using an old drive!

What if you want to use the computer and the drive is elsewhere?

In a modern computer, this won't matter unless, of course, the drive is the only one in which case you're up the proverbial creek! Yes, it will probably give you an error message saying that the drive is not there – just say thank you very much and keep working!

In the case of computers which auto detect, it will auto detect that there is nothing there and continue on its merry way. Next time you plug the drive in, it will auto detect that it is back again (naturally, you'd never think of removing or inserting the drive with the computer power on, would you?).

Note that these comments only apply if the disc drive is the same type, master or slave, on both computers. If you want to change from being a master drive on one computer to a slave drive on another, you will almost definitely have to change the jumper to suit.

Security

Using the mobile rack also has major pluses as far as security of information is concerned. If you handle sensitive or valuable information, you would be aware of the problems in ensuring that only your eyes see it! Even worse, industrial espionage is on the increase and we've all heard the horror stories about hackers getting in to company information.

With the Mobile Rack, when you go home at night, the whole hard disc can go home with you. No-one, not even the world's best hacker, can open up your files if they aren't there!

Even if you don't have this type of problem, you should have a backup copy of your company data off site. The mobile rack makes it delightfully simple because as far as the computer is concerned, the hard disc it contains is just that – another hard disc that can be copied to. When the backup is done you simply remove it for safe storage.

Looking at the other side of the coin for a moment, what about the security of the hard disc itself? Doesn't making it removable make it easier to steal? Thankfully, the makers of the mobile rack are one step ahead: they've included a keyed lock which holds the frame (and therefore the disc drive) firmly in place. To remove, simply turn the key and withdraw it.

Be warned, though – just like all those millions of disc boxes out there which secretaries around the world dutifully lock up each night, it would appear that one key fits all. So if you have a really determined thief . . . (nah, forget it: if he's that determined he'd simply knock off the whole damn computer, anyway!). **SC**

Where To Buy the HDD Carrier & Frame

The "Mobile Rack" (or removable hard disc carrier & frame) is available from any Jaycar Electronics store. It comes in two versions: (1) Cat. XC-4670 for IDE drives; and (2) Cat. XC-4671 for SCSI drives. Both versions cost $39.95. For further information, contact Jaycar Electronics, 8-10 Leeds St, Rhodes, NSW 2130. Phone (02) 9743 5222; fax (02) 9743 2066.

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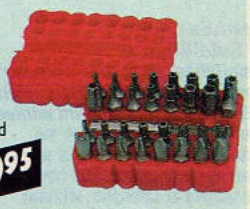

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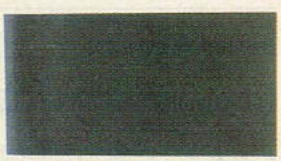

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- Accurately determines the RPM of your car engine/machine
- 5 digit display
- Displays with a 1 RPM resolution
- Presettable digital multiplier for calibration
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- Display can be dimmed for night time use
- Leading "0" blanking
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- Generates high quality colour bars
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- Patterns and sync stored on ROM with option to change patterns
- Power source req: 240VAC
- With components, hardware, PCB, video modulator, EPROM, case and pre-punched screened front panel.

K 7380

$149

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Availability: Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied as to their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however if you'd like to check beforehand, please don't hesitate to contact your local store.

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- You'll be able to find out who is at the door before you open it.
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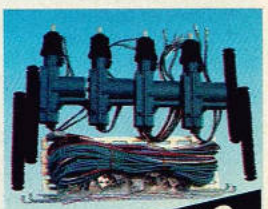

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- Clock with alarm.
- Weather forecast icons.
- Electroluminescent backlight for night viewing.
- Uses 4 x "AAA" batteries.

D 3948

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Glowlite Illuminated Numbering System

- Visible 20m away day or night.
- Automatically switches on at dusk.
- Helps visitors, emergency services, taxis and home deliveries find your premises.
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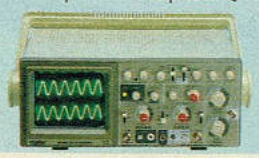

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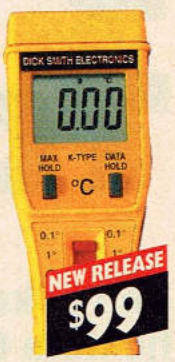

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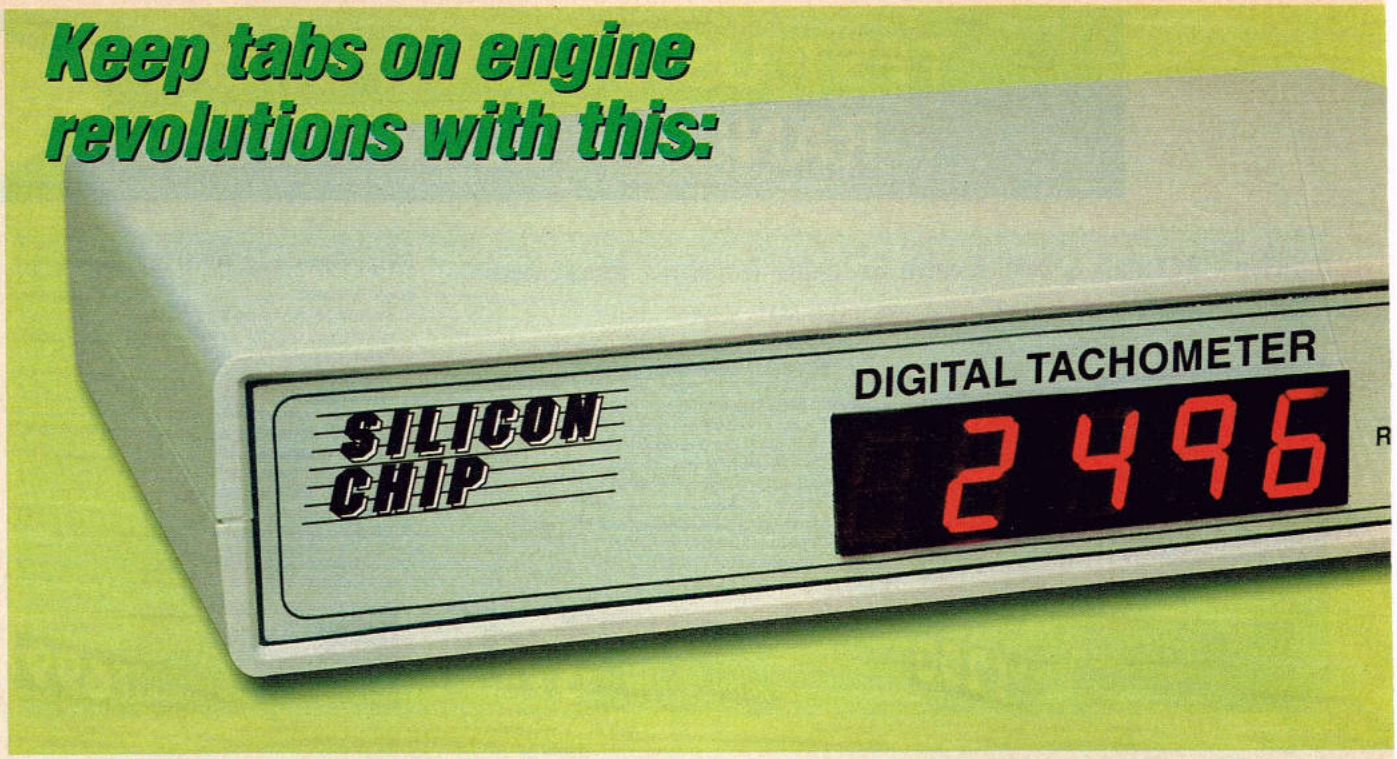


5-Digit Tachometer

You asked for it and here it is: a highly flexible tachometer circuit that should cope with virtually any engine or rotating machinery. It has a crystal timebase and a resolution of one revolution per minute (1 rpm).

Main Features

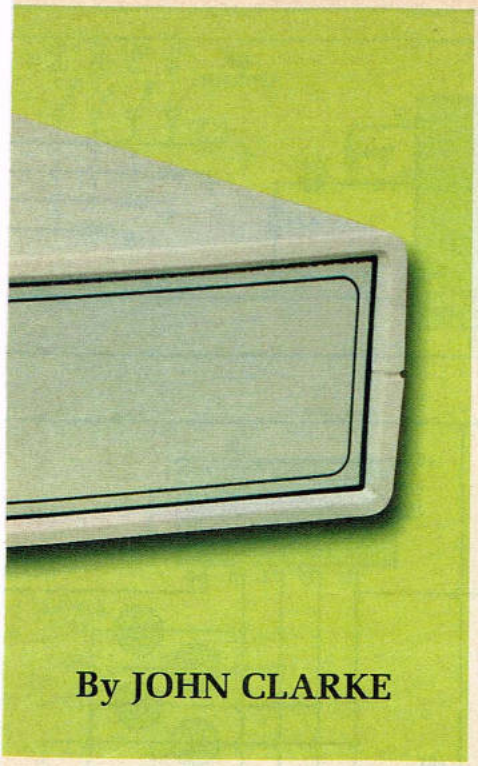
- 5-digit readout
- 1 rpm resolution
- crystal timebase
- presettable digital multiplier for calibration
- 0.25 second update
- facility for last digit to be locked on "0"
- display can be dimmed for night time use
- leading zero blanking

Let's face it, everyone loves those large tachometers with 270 degree movements. There is a strong temptation to make the needle sweep around the dial as you push down on the GO pedal.

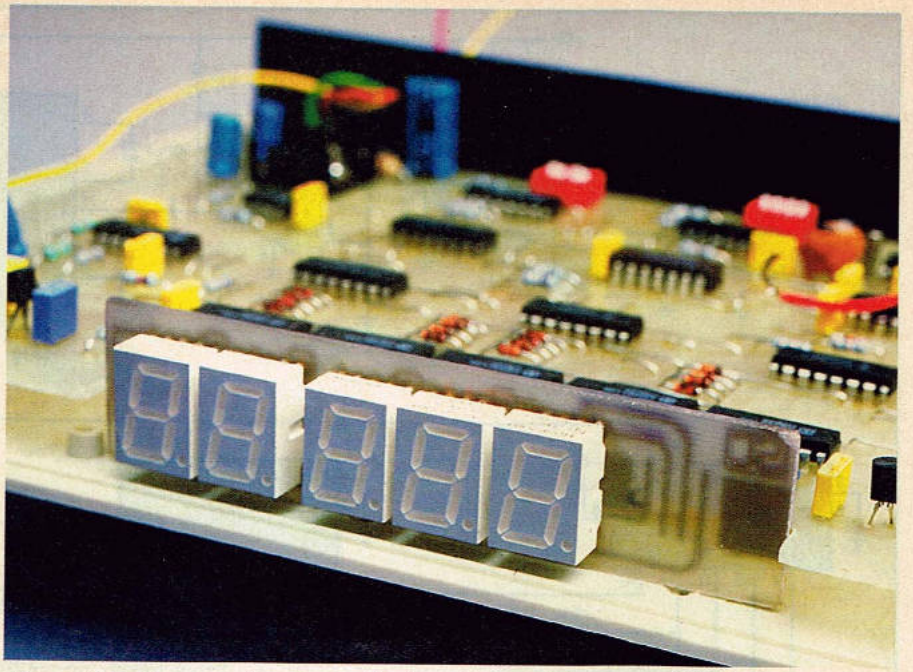
But while they look the part, traditional analog tachometers are not particularly accurate and have a very poor resolution which means that you can't precisely measure a particular engine speed such as 1450 rpm. For this reason, they cannot be used for accurately tuning an engine for correct mixture (done by adjusting for maximum idle speed) or procedures like setting the throttle switch for EFI engines.

So there is a need for a digital tacho with much greater accuracy and resolution.

Our new digital tachometer is mounted in a relatively large low profile case, measuring 225mm wide, 165mm deep and 40mm high. This is not the sort of project which could be easily integrated into your car's dash



By JOHN CLARKE



Above: this close-up view shows the board assembly mounted in the case before the front panel is fitted. Take care to ensure that the 7-segment LED displays are mounted correctly (decimal points to bottom right).

board unless the small PC board with the 7-segment displays is mounted separately. But we're getting way ahead of ourselves . . .

Why such a large case? The answer is that a 5-digit tachometer is quite complex and no off-the-shelf ICs will do the job required. A custom microprocessor could but our previous experience with these sorts of projects indicates that our readers much prefer circuits with readily available ICs.

Just to give an example of an IC that is relatively available and could do most of the job, consider the National Semiconductor 74C926. This is a 4-digit counter with a multiplexed display. But we need five digits (or rather, you the readers, appear to want five digits) and the 74C926 does not have leading zero blanking. A tachometer without leading zero blanking looks pretty silly so that rules the 74C926 out of the picture. Sure, we could have added in leading zero blanking but then the advantages of a single chip 4-digit counter go out the window.

So we have ended up with a relatively large PC board with quite a few ICs on it. Er, just how many are there? Well, 16 to be precise, not counting the 3-terminal regulator. But all the ICs are cheap and readily available.

OK, so we've been up-front about the size of the 5-Digit Tachometer and all its ICs, let's describe its features.

Features

The SILICON CHIP 5-Digit Tachometer will accurately read the revs of an engine or any rotating shaft with a resolution of 1 rpm and it will read high shaft speeds up to 60,000 rpm. The accuracy is a function of the crystal controlled timebase and the usual counter accuracy of ±1 digit. For example, a reading of 12,000 rpm would have an accuracy of ±1 rpm plus the timebase accuracy of say, less than 50

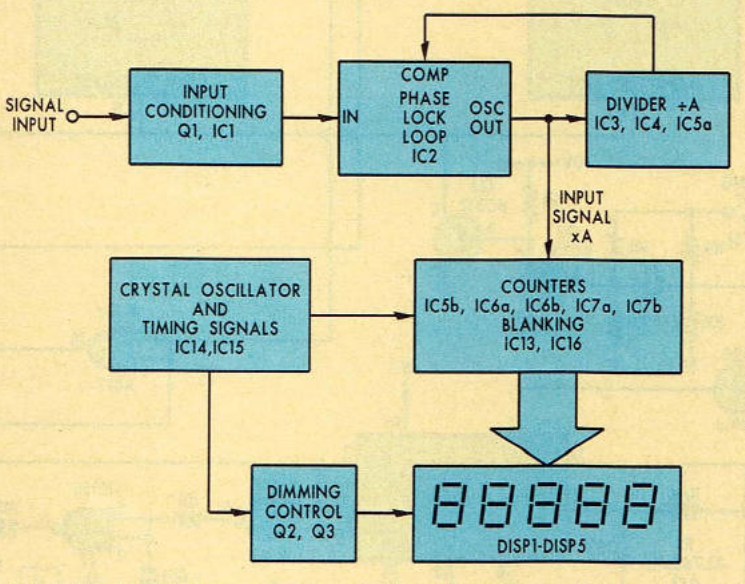
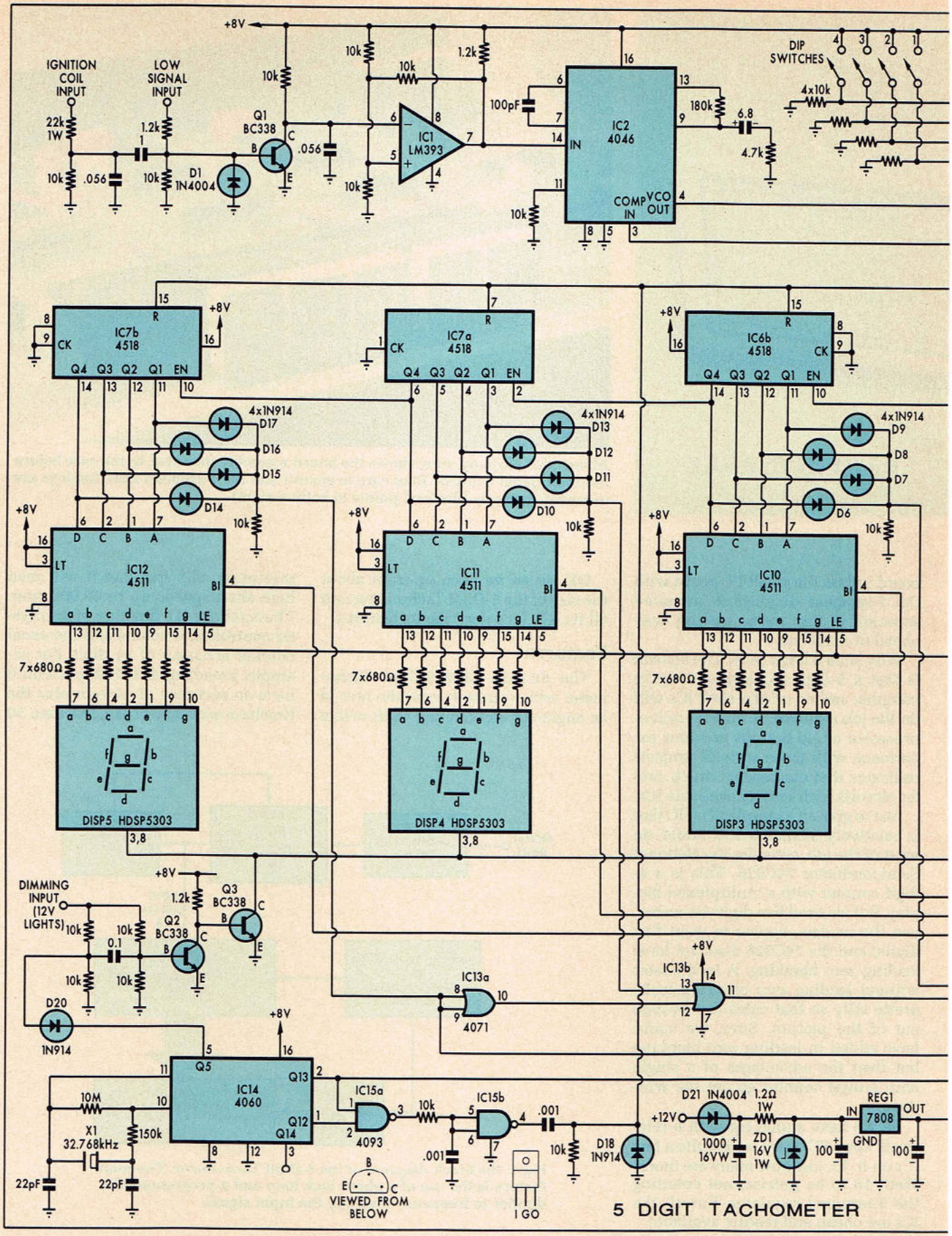


Fig.1: the block diagram of the 5-Digit Tachometer. The main feature is the use of a phase lock loop and a programmable divider to frequency multiply the input signal.


IGNITION COIL INPUT
LOW SIGNAL INPUT
22k 1W
1.2k
10k
.056
D1 1N4004
Q1 BC338
+8V
10k
1.2k
IC1 LM393
100pF
IC2 4046
DIP SWITCHES
4x10k
180k
6.8
4.7k
COMP IN
VCO OUT
IC7b 4518
IC7a 4518
IC6b 4518
Q4 Q3 Q2 Q1 EN
4x1N914
D17
D16
D15
D14
D13
D12
D11
D10
D9
D8
D7
D6
IC12 4511
IC11 4511
IC10 4511
D C B A
LT
BI
a b c d e f g LE
7x680Ω
DISP5 HDSP5303
DISP4 HDSP5303
DISP3 HDSP5303
3,8
DIMMING INPUT (12V LIGHTS)
0.1
Q2 BC338
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D20
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IC13b
4071
IC14 4060
Q5
Q13
Q12
Q14
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IC15b
4093
.001
D18 1N914
D21 1N4004
1.2Ω 1W
+12V
1000 16VW
ZD1 16V 1W
REG1
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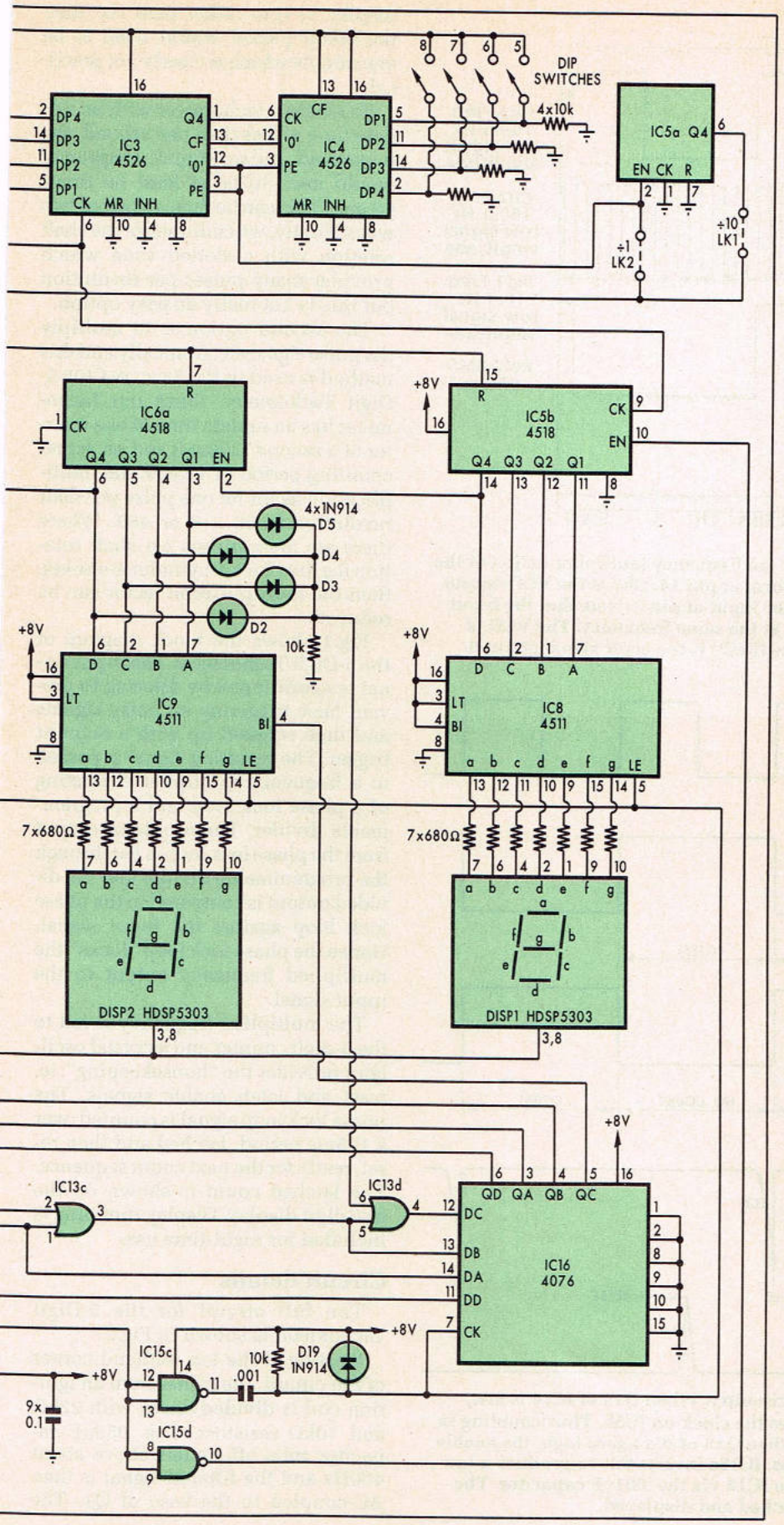


Fig.2 (left): the tachometer uses five decade counters to provide a 5-digit display. The diode OR gates provide leading zero blanking for the four most significant digits.

parts per million, which is negligible in this application.

Making a tachometer to suit a wide range of engines is a real problem because you have to cater for so many cylinder, coil and 2-stroke/4-stroke combinations. Just to give you an idea of the complexity involved, we have had to cater for 1, 2, 3, 4, 5, 6, 8, 10 and 12-cylinder engines with single and multi-ignition coil combinations and 2-stroke and 4-stroke engines. Doubtless there'll be some engines we have omitted but we can't think of any.

Catering for all these possibilities is provided by DIP switches and two links on the PC board.

The new tacho's input circuitry can accept high voltage from the primary winding of an ignition coil or small signals from a shaft position sensor or engine management tachometer output. And if you have a TAI or CDI system, you would also feed the low-voltage signal from the points, Hall effect sensor or reluctor pickup to the low-signal input.

The tachometer can also be set to allow for one pulse per shaft revolution to a maximum of 60. The rpm measurement update time is one quarter of a second so there will be a new reading four times each second.

In cases where the machine or engine rotation is not stable, the last display digit can fluctuate widely which makes it difficult to take a sensible reading. To cope with this situation, we have provided a facility to lock the last digit to 0 if required. In this case the reading resolution will be reduced to 10 rpm.

Frequency multiplication

Measuring shaft rpm with a high resolution can be difficult since most motors rotate rather slowly, in electronic terms. For example, a shaft turning at 1000 rpm with one trigger pulse per revolution will provide a signal frequency of 1000/60 Hz or 16.67Hz to the tachometer. A normal frequency counter circuit with a 1-second count period will simply display a reading of 16 or 17. This is equivalent to 1Hz or only 60 rpm resolution. If it was to

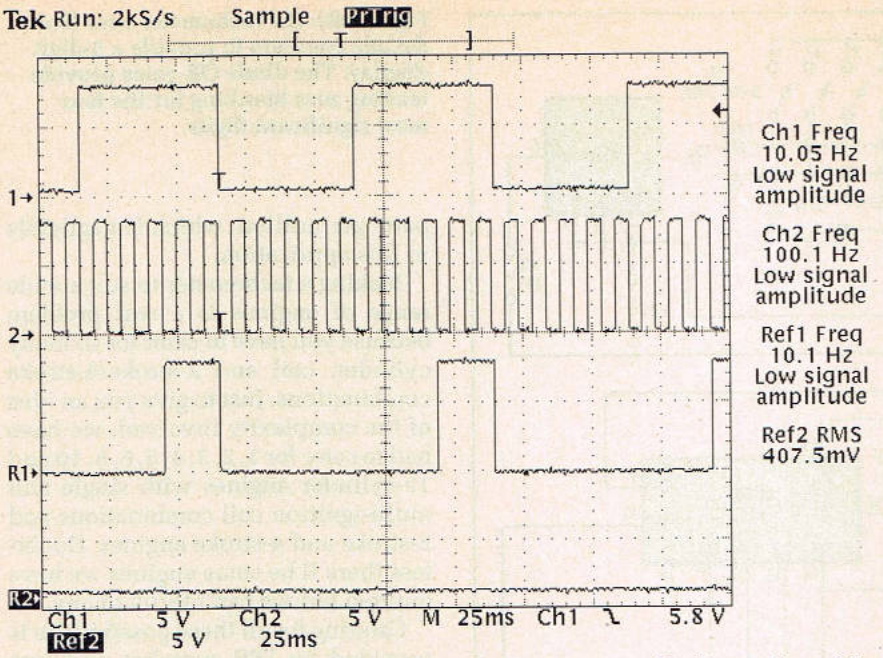


Fig.3: these oscilloscope waveforms show the frequency multiplier action of the PLL (IC2). At top (Ch1) is the input waveform at pin 14. Ch2 is the VCO output while the Ref1 waveform is the comparator input at pin 3. Note that the input and comparator signals are in phase and at the same frequency. The VCO is shown multiplying by 10. The lowest trace (Ref2) is the error signal at pin 9.

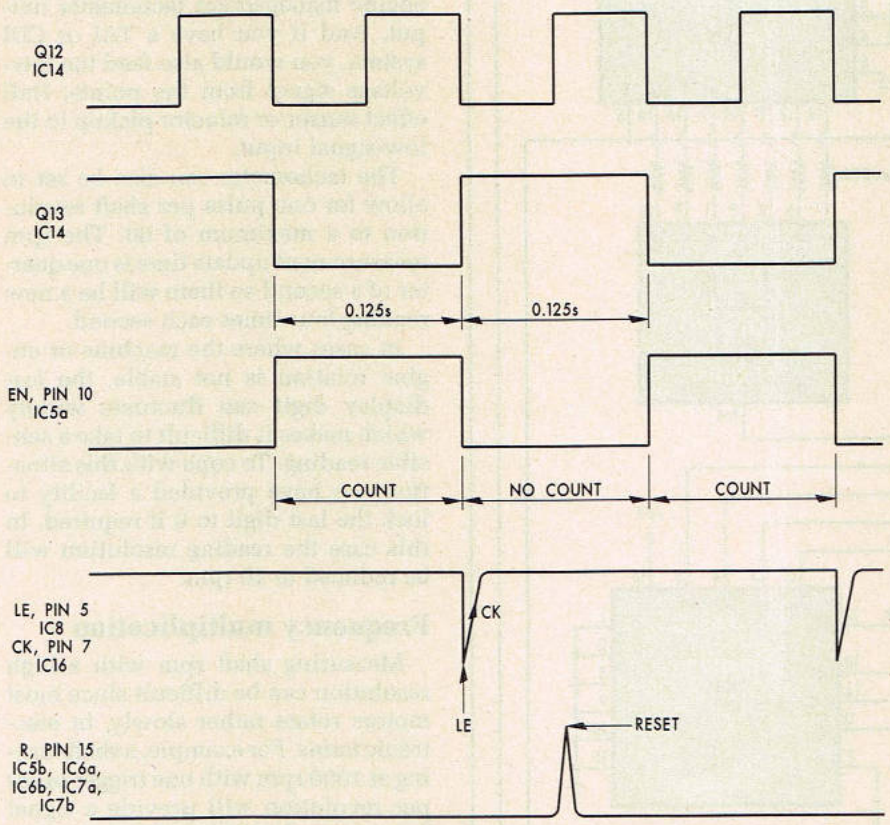


Fig.4: timing waveforms for the counter circuitry. When Q13 of IC14 is low, NAND gate IC15d inverts this and enables the clock on IC5b. Thus counting in IC5b and following counters can start. When Q13 of IC14 goes high, the enable input to IC5b goes low and counting stops. IC15c inverts this to produce a low signal to the latch enable inputs on IC8 to IC12 via the .001µF capacitor. The value counted by IC5b to IC7b is then latched and displayed.

display in rpm rather than Hz, then the count period would need to be one minute which is clearly not practical.

To obtain a tachometer with an update time of less than one second, the measured pulse signal frequency would need to be at least 60 times greater. This can be done in one of two ways. Firstly, we could sense the shaft rotation with a slotted vane which provides many pulses per revolution but this is not really an easy option.

The second option is to multiply the pulse signal electronically and this method is used in the SILICON CHIP 5-Digit Tachometer. Since our tachometer has an update time of one quarter of a second (250ms) and an actual counting period of 125ms, the multiplication factor for one pulse per shaft revolution is 60 x 8 or 480. Where there are more pulses per shaft rotation (eg, two for a 4-cylinder 4-stroke), then the multiplication factor can be reduced.

Fig.1 shows the block diagram of the 5-Digit Tachometer. The input signal is conditioned by filtering to prevent false triggering on noisy signals and then squared up with a Schmitt trigger. The resulting signal is passed to a frequency multiplier consisting of a phase lock loop and a programmable divider. The oscillator output from the phase lock loop is fed through the programmable divider and the divided output is compared in the phase lock loop against the input signal. Hence the phase lock loop "locks" the multiplied frequency output to the input signal.

The multiplied frequency is fed to the 5-digit counter and a crystal oscillator provides the "housekeeping"; ie, reset and latch enable signals. The phase lock loop signal is counted over a 125ms period, latched and then reset, ready for the next count sequence. The latched count is shown on the five digit display. Display dimming is included for night-time use.

Circuit details

The full circuit for the 5-Digit Tachometer is shown in Fig.2.

Starting at the top lefthand corner of the circuit, the signal from an ignition coil is divided down with 22kΩ and 10kΩ resistors. The .056µF capacitor rolls off signals above about 400Hz and the filtered signal is then AC-coupled to the base of Q1. The

10kΩ resistor between base and emitter holds Q1 off in the absence of a voltage on the ignition coil input. The 1.2kΩ resistor at Q1's base is there to provide a low voltage signal input point which can drive the transistor with as little as 1V peak-to-peak. The collector of Q1 is pulled to the 8V supply via a 10kΩ resistor and its output is filtered with another .056µF capacitor.

IC1 is an LM393 dual comparator with only one section used in our circuit. The comparator is connected as a Schmitt trigger with hysteresis set by positive feedback between the output at pin 7 and the non-inverting input at pin 5. The pin 7 output is an open collector transistor and when it is off, the 1.2kΩ resistor pulls it high. A voltage divider at the non-inverting input (pin 5), formed by the two 10kΩ resistors across the supply and the 10kΩ feedback resistor, sets this input at +5.23V.

The signal from Q1's collector must go higher than this to drive the comparator output at pin 7 low. When the output is low, the same voltage divider action sets the non-inverting input at +2.77V and so the collector of Q1 must go below this voltage before IC1's output will again go high.

The wide hysteresis (about 2.5V) on IC1 ensures that any noise on Q1's collector will be ignored.

Phase lock loop

Following IC1 is the phase lock loop (PLL), IC2. This oscillates at a maximum frequency set by the 100pF capacitor and resistor at pin 11. The actual frequency is controlled by the input voltage at pin 9. When pin 9 is at the full supply voltage, the oscillator runs at the maximum rate. When pin 9 is close to 0V, the oscillator runs at its slowest speed. This is nominally more than 100 times slower than the maximum rate.

The PLL's oscillator output at pin 4 is fed to programmable dividers IC3 and IC4. IC3 divides from 1 to 15, depending on the switch settings on DIP1-DIP4. If only DIP1 is set high, the IC divides by 1. When all switches are closed, the IC divides by 15. IC4 divides by 16 when only DIP5 is closed and this increases to 255 when DIP5-DIP8 are all closed. Thus, when IC3 and IC4 are used together, we can divide from 1 up to 255 + 15, or a total of up to 270 in steps of 1.

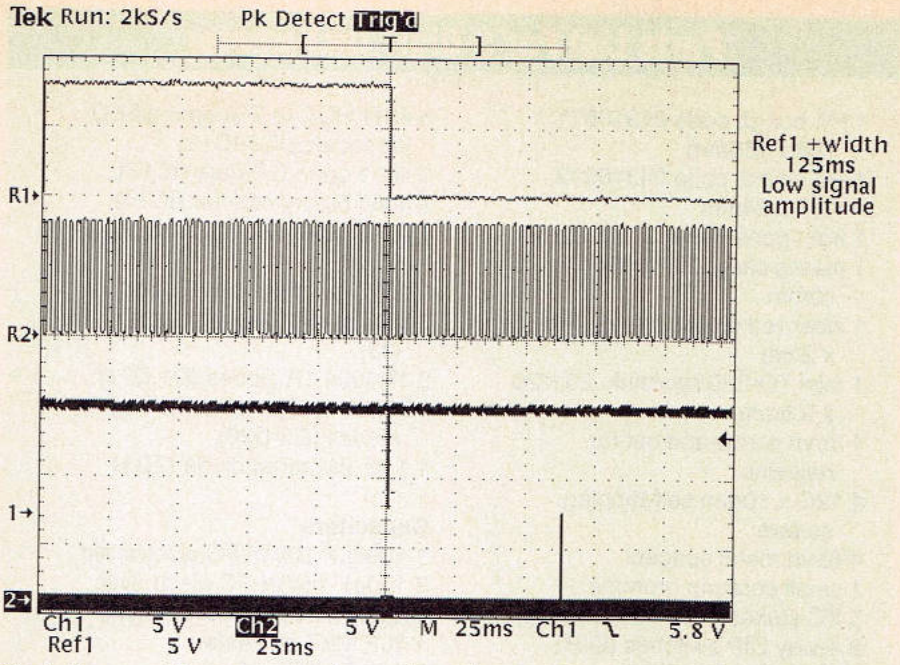


Fig.5: these oscilloscope waveforms show the timebase circuitry in action. The top trace shows the enable signal to pin 10 of IC5b. The second trace is the clock signal (pin 9) which is counted when pin 10 is high. The low pulse on the third trace latches the counted data into IC8, IC9, IC10 and IC11. The positive edge of the pulse clocks D-flipflop IC16. The reset pulse on the fourth trace resets counters IC5b-IC7b.

The output from the programmable dividers is passed to the enable input of IC5a. This is a binary coded decimal (BCD) counter which divides by 10 at its Q4 output. With the inclusion of IC5a, the overall division can be up to 2700. There are two link options, with LK1 selecting divide by 10 and LK2 selecting divide by 1.

Following IC5a, the divided signal is applied to the comparator input of the PLL at pin 3 and this is compared with the tacho input signal at pin 14. The PLL produces an error signal at pin 13 which after filtering is applied to the voltage controlled oscillator input at pin 9.

The rate at which the PLL tracks the incoming signal is set by the filter components at pin 9. The 6.8µF capacitor in conjunction with the 180kΩ resistor sets the lowest frequency for

Specifications

Readout range	>100 to 1
Maximum reading	nominal 60,000 rpm with 0.25 second update
Multiplier settings	from x1 to x270 in steps of 1; x270 to x2700 in steps of 10
Resolution	1 rpm maximum or 10 rpm if last digit locked on 0
Accuracy	±1 digit (crystal locked)
Count period	0.125s (1/8s)
Update period	0.25s (1/4s)
Input sensitivity	3V p-p on ignition coil input and 1V p-p on low signal input
Maximum Input Voltage	600V on ignition coil input, 120V on low signal input

Parts List For 5-Digit Tachometer

1 PC board, code 04310971, 198 x 155mm
1 PC board, code 04310972, 104 x 24mm
1 front panel label, 215 x 32mm
1 plastic case, 225 x 165 x 40mm
1 clear red plastic sheet, 74 x 19 x 2mm
1 mini TO-220 heatsink, 20 x 20 x 9.5mm
1 3mm screw and nut for heatsink
4 12G x 10mm self-tapping screws
4 6mm metal spacers
1 small cordgrip grommet
5 PC stakes
2 4-way DIP switches (DIP1-DIP4 & DIP5-DIP6)
1 2m length of 0.8mm tinned copper wire
1 32.768kHz crystal (X1)

Semiconductors
5 HDSP5303 common cathode 12.5mm LED displays (DISP1-DISP5)
1 7808 8V positive regulator (REG1)
1 LM393 dual comparator (IC1)
1 4046 phase lock loop (IC2)
2 4526 programmable binary dividers (IC3, IC4)
3 4518 dual BCD counters (IC5-IC7)
5 4511 BCD to 7-segment LED decoders (IC8-IC12)
1 4071 quad OR gate (IC13)
1 4060 binary counter (IC14)
1 4093 quad Schmitt NAND gate (IC15)
1 4076 quad flipflop (IC16)
3 BC338 NPN transistors (Q1-Q3)
2 1N4004 1A diodes (D1,D21)
19 1N914, 1N4148 switching diodes (D2-D20)
1 16V 1W zener diode (ZD1)

Capacitors
1 1000µF 16VW PC electrolytic
2 100µF 16VW PC electrolytic
1 6.8µF 16VW PC electrolytic
1 1µF MKT polyester
9 0.1µF MKT polyester
2 .056µF MKT polyester
3 .001µF MKT polyester
1 100pF MKT polyester or NP0 ceramic
2 22pF NP0 ceramic

Resistors (0.25W 1%)

1 10MΩ	1 4.7kΩ
1 180kΩ	3 1.2kΩ
1 150kΩ	35 680Ω
1 22kΩ 1W	1 1.2Ω
25 10kΩ	

Miscellaneous
Hookup wire, connectors, solder, etc.

which it will lock, while the 4.7kΩ resistor in series with the 6.8µF capacitor improves the response time when the circuit locks.

The oscilloscope waveforms in Fig.3 show the PLL (IC2) in action. At top (Ch1) is the input waveform at pin 14. Ch2 is the VCO output while the Ref1 waveform is the comparator input at pin 3. Note that the input and comparator signals are in phase and at the same frequency. The VCO is shown multiplying by 10. The lowest trace (Ref2) is the error signal at pin 9.

4-bit counters

The VCO output from IC2 clocks the second 4-bit BCD counter in IC5; ie, IC5b. Its outputs at Q1-Q4 are decoded by IC8 which is a 4511 BCD to 7-segment LED display driver. Thus, the LED display shows the count value from IC5b. The divide-by-10 output at Q4 of IC5b clocks the following IC6a counter at its enable input, pin 2.

Similarly, IC6b, IC7a and IC7b are clocked from the Q4 outputs of the previous counter stage. Each of these counters drives its own 7-segment decoder (IC10-IC12).

Leading zero blanking

Diodes D2-D17, IC13 and IC16 provide leading zero blanking for the LED displays. This means that instead of the display indicating 00651, for example, it will only show 651, with the leading two zeros unlit. This makes the display far easier to read. The leading zero blanking works by monitoring the Q1-Q4 count outputs of the 4518 counters (ie, IC6a-IC7b) via the diodes which are connected as OR gates.

If the BCD output from IC7b is zero (ie, outputs Q1-Q4 low), then the common cathode connection of diodes D14-D17 will be held low via the 10kΩ resistor connecting this point to ground. This low level is applied to data input DD of quad D flipflop IC16. The corresponding QD output when clocked at pin 7 applies a low to the blanking input of IC12 at pin 4 to turn off the display.

IC13b is a 2-input OR gate which monitors the diode OR gate D10-D13 for IC7a and the D14-D17 diode OR gate signal via IC13a. If both inputs to IC13b are low, then its pin 11 is low. This low output is applied to the DA input of IC16 and is clocked to the QA output and thence to the blanking input of IC11. If there is other than a zero count at least one diode will pull an input of IC13b high to prevent blanking.

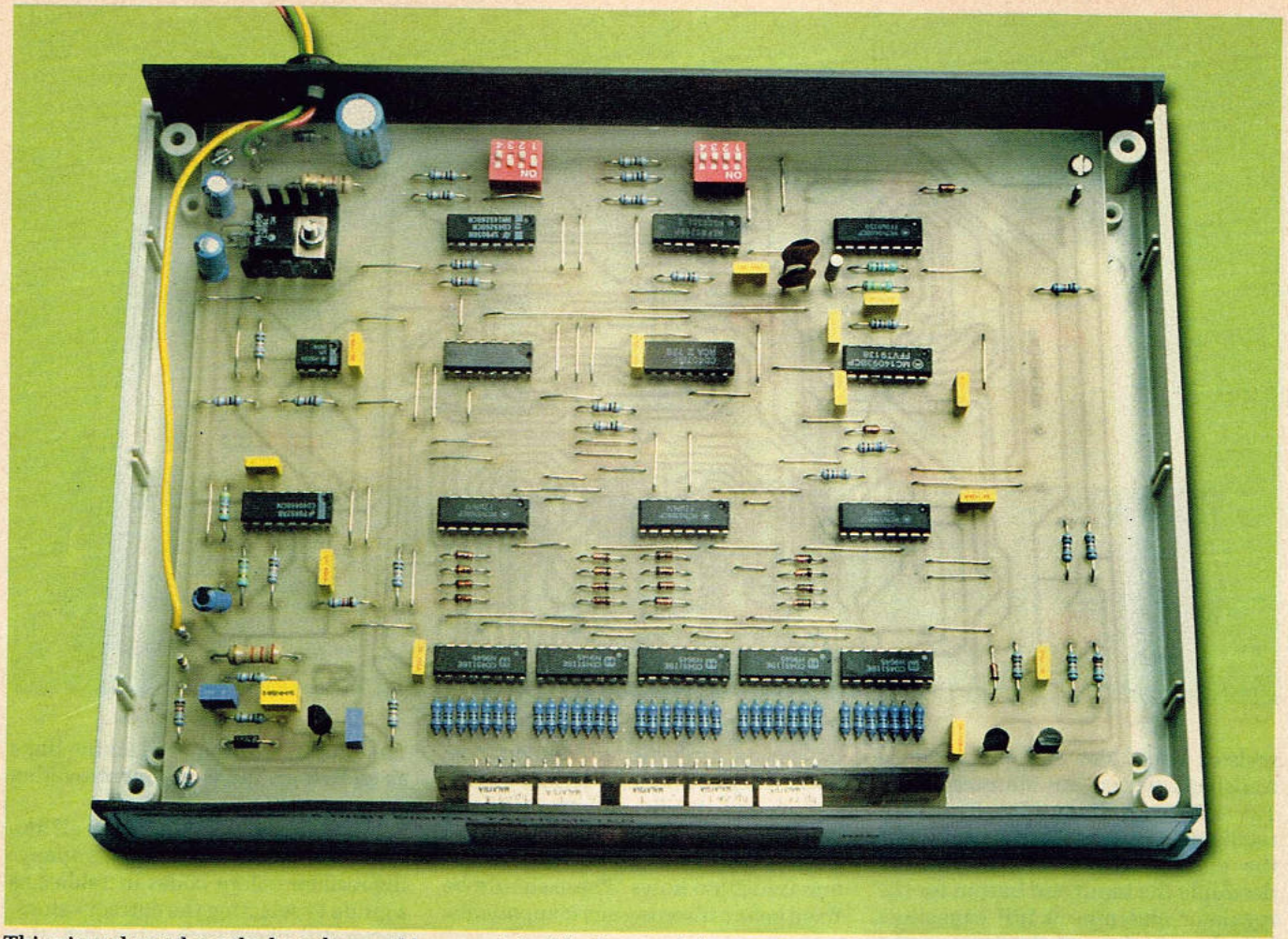
A similar scenario occurs with IC6b, IC6a and the associated diodes driving IC13c and IC13d. Note that the blanking circuit relies on the information from the most significant digits. If for example, IC13a's output is high due to a count higher than zero for IC7b, the IC13b, IC13a and IC13d OR gates will have high outputs and no blanking will occur. Thus as soon as a more significant digit has a count more than 1, the following less significant digits cannot be blanked.

IC16 is used to latch in the leading zero blanking after the IC6a to IC7b counters have counted the signal from IC2. If these blanking signals were not latched, then the leading zero feature would be lost as the counters made their next count from zero.

Timing

A 32.768kHz crystal oscillator is formed across the inverter at pins 10 and 11 of IC14. The 10MΩ resistor biases the inverter while the 150kΩ resistor and the 22pF capacitors across the crystal prevent it from oscillating in a faster spurious mode. The Q12 and Q13 outputs of IC14 produce 4Hz and 2Hz respectively.

Fig.4 shows the timing waveforms for the counter circuitry. When Q13 of IC14 is low, NAND gate IC15d inverts this and enables the clock on IC5b. Thus counting in IC5b and the follow-



This view shows how the board assembly mounts inside the case. The two 4-way DIP switches are used to set the PLL multiplication ratio so that the unit can be made to work with virtually any 2-stroke or 4-stroke engine.

ing counters can start. When Q13 of IC14 goes high, the enable input to IC5b goes low and counting stops. IC15c inverts this to produce a low signal to the latch enable inputs on IC8-IC12 via the .001µF capacitor. The value counted by IC5b-IC7b is then latched and displayed.

The .001µF capacitor charges via the 10kΩ resistor to the positive supply and the rising edge clocks the leading zero data on DA-DD on IC16 to the QA-QD outputs. Diode D19 prevents the pin 7 input of IC16 going above the positive supply when IC15c's output goes high again.

When both Q12 and Q13 of IC14 go high, the pin 3 output of NAND gate IC15a goes low. The resulting high on the pin 4 output of IC15b resets the 4518 counters via the .001µF capacitor. Diode D18 prevents excursions below ground when IC15b goes low. The 10kΩ resistor and .001µF capacitor between the output of IC15a and the input to IC15b produce a short delay to prevent unwanted resets as Q12 goes low and Q13 goes high at the end of the count sequence.

The oscilloscope waveforms of Fig.5 show the timebase circuitry in action. The top trace shows the enable signal to pin 10 of IC5b. The second trace is the clock signal (pin 9) which is counted when pin 10 is high. The low pulse on the third trace latches the counted data into IC8, IC9, IC10 and IC11. The positive edge of the pulse clocks D-flipflop IC16. The reset pulse on the fourth trace resets counters IC5b-IC7b.

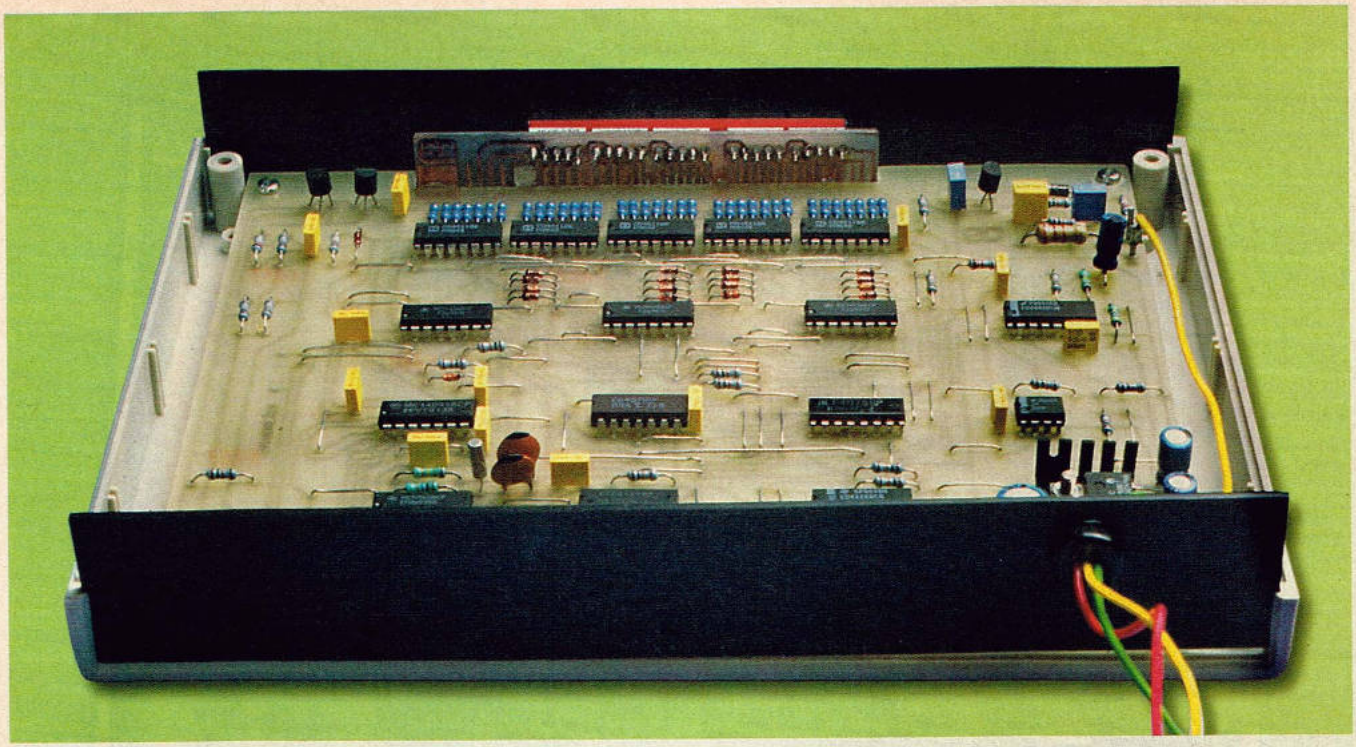
Display dimming

The 7-segment displays DISP1 to DISP5 have their common cathodes connected to the collector of Q3. If transistor Q2 is off, then Q3 is turned on via the 1.2kΩ base resistor. This provides the full brightness to the displays via their 680Ω anode resistors.

Diode D20 and transistor Q2 provide the dimming control feature. Diode D20 feeds a 1024Hz signal from pin 5 of IC14 to the input of Q2. When the Q5 output of IC14 is low, the base of Q2 is momentarily pulled low via the 0.1µF capacitor, switching off the transistor and allowing Q3 to turn on and light the display. The 0.1µF capacitor charges up via the 10kΩ base resistor on Q2 and so the transistor turns on again, turning Q3 and the displays off.

Since the displays are turned on and off at 1024Hz there is no apparent flicker and the proportion that Q3 is on sets the brightness. This is determined by the 0.1µF capacitor value and this can be increased for a brighter display.

Power for the circuit comes from the 12V battery in a car or a 12V DC 500mA plugpack. Diode D21 prevents a reversed polarity connection from damaging the circuit. A 1000µF capacitor filters the supply, while a 1.2Ω



resistor decouples the supply from transients which are shunted using 16V 1W zener diode ZD1. The 7808 regulator provides the 8V supply for the circuit. Two 100µF capacitors decouple the input and output for the regulator and nine 0.1µF capacitors help bypass the supply lines on the PC board.

Construction

The 5-Digit Tachometer is constructed on two PC boards. The main PC board is coded 04310971 and measures 198 x 155mm, while the display PC board is coded 04310972 and measures 104 x 24mm. The display is designed to attach at rightangles to the main PC board.

As already noted, the tachometer is housed in a plastic instrument case measuring 225 x 165 x 40mm.

You can begin construction by checking the PC boards for etching defects such as shorts between tracks and undrilled holes. These should be fixed before inserting any components.

Table 1: Capacitor Codes

❑	Value	IEC Code	EIA Code
❑	1µF	1u	105
❑	0.1µF	100n	104
❑	.056µF	56n	563
❑	.001µF	1n	102
❑	100pF	100p	101
❑	22pF	22p	22

Then insert and solder in all the links as shown on the component overlay diagram of Fig.6.

Next, insert and solder in all the resistors. You can use the accompanying resistor colour codes in Table 2 as a guide to selecting the correct values. Better still, check each value with your digital multimeter before soldering it in. The ICs and DIP switches can be installed next, taking care with their orientation. Be sure to put the correct IC in each position.

When soldering in the diodes, note that D21 and D1 (both 1N4004) are larger bodied than the others (1N914s). Take care with their orientation. Insert the capacitors and note that the electrolytic capacitors need to be inserted with the polarity shown. Table

Table 2: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	10MΩ	brown black blue brown	brown black black green brown
❑	1	180kΩ	brown grey yellow brown	brown grey black orange brown
❑	1	150kΩ	brown green yellow brown	brown green black orange brown
❑	1	22kΩ	red red orange brown	red red black red brown
❑	25	10kΩ	brown black orange brown	brown black black red brown
❑	1	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	3	1.2kΩ	brown red red brown	brown red black brown brown
❑	35	680Ω	blue grey brown brown	blue grey black black brown
❑	1	1.2Ω	brown red gold brown	brown red black silver brown

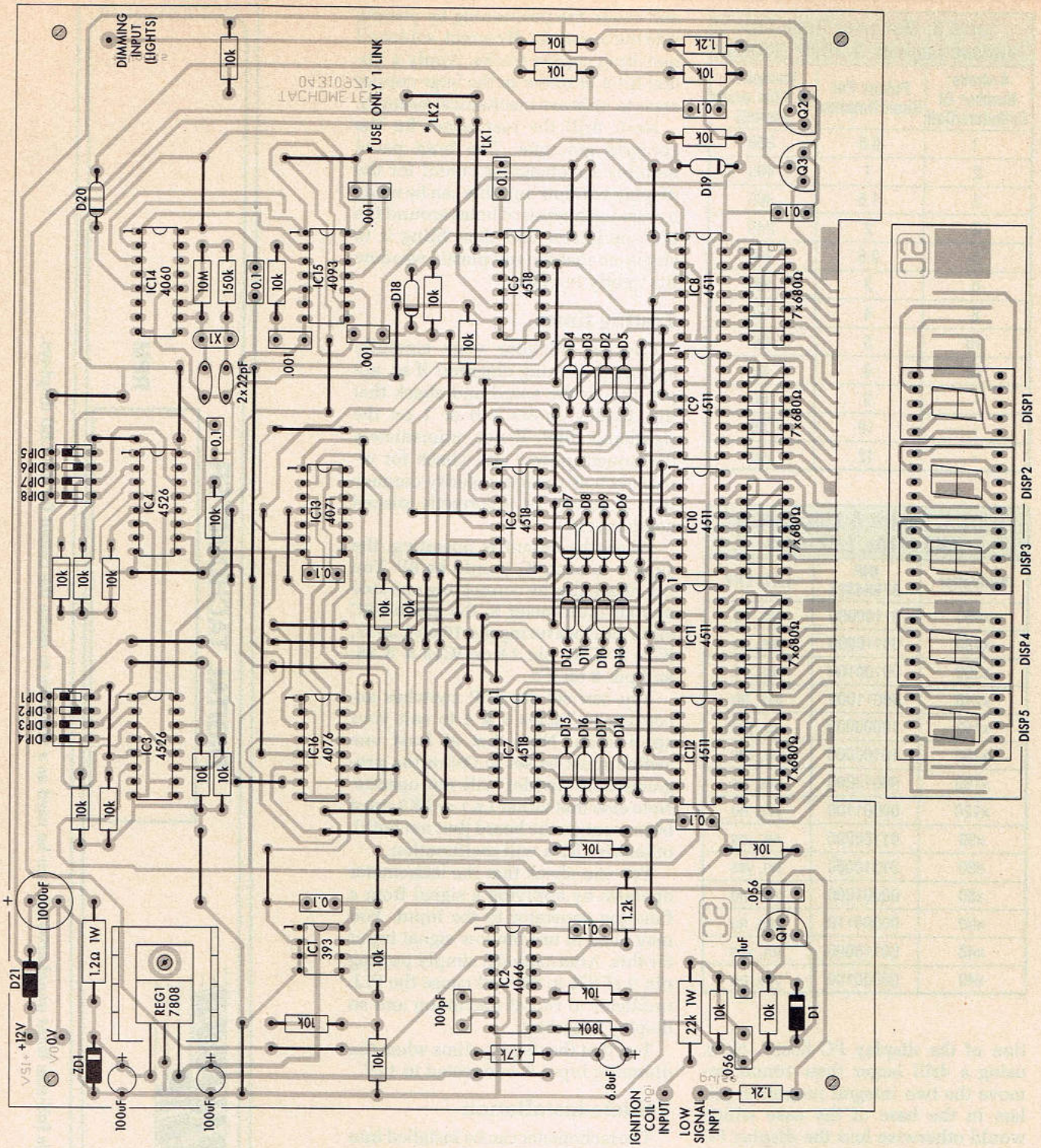


Fig.6: this diagram shows the component layout on the main and display PC boards. When mounting the LED displays on the small board, make sure that the decimal points are located in the bottom righthand corner.

1 shows the codes which will be shown on MKT and ceramic capacitors.

The 3-terminal regulator REG1 is mounted horizontally with its metal face towards the PC board and a small heatsink beneath it. Bend the leads before inserting it into place. It is secured with a screw and nut.

Next, insert the PC stakes, transistors and the crystal. When inserting the displays on the smaller PC board be sure that the decimal point is located in the bottom righthand corner. Note that the decimal points are not used in this circuit.

Case work

Attention can now be turned to the case. First, temporarily place the main board in position and check the loca-

Table 3: Multiplier Ratio For Various Engines & Shaft Pickups		
4-stroke: Number Of Cylinders/Coil	Pulses Per Shaft Rotation	Multiplier (0.125s count period)
1	0.5	960
2	1	480
3	1.5	360
4	2	240
5	2.5	192
6	3	160
8	4	120
10	5	96
12	6	80
-	8	60
-	10	48
-	12	40

Table 4: Switch & Link Settings (LK1 = 10x, LK2 = 1x)		
Multiplier	DIP 87654321	LK1, LK2
x960	01100000	yes, no
x480	00110000	yes, no
x360	00100100	yes, no
x240	00011000	yes, no
x192	10000000	no, yes
x160	10100000	no, yes
x160	00010000	yes, no
x120	00001100	yes, no
x96	01100000	no, yes
x80	01010000	no, yes
x80	00001000	yes, no
x60	00000110	yes, no
x48	00110000	no, yes
x40	00000100	yes, no

tion of the display PC board. Now, using a drill larger than 10mm, remove the two integral mounting pillars in the base of the case which would otherwise foul the display PC board when it is placed in position.

Place the main PC board in position over the integral standoffs, using 6mm spacers to raise it, Secure it with self-tapping screws. Now place the display PC board vertically in position and mark the rear of this board where the main PC board makes contact. Remove both PC boards and tack solder them together at the large copper areas. Make sure they are at right angles and check the positioning by placing into the box again. If correct, solder all matching copper tracks. Apply a liberal fillet of solder to the large copper areas to improve mechanical strength.

Next, drill the rear panel for the cordgrip grommet. The front panel requires a rectangular cutout for the display window and this can be made by making a series of holes around the hole perimeter and then filing it to shape, so that the red plastic window fits tightly in place.

Testing times

Checked all your work carefully against the wiring diagram? If so, apply 12V to the board and check that the display shows a 0 or 1 on the righthand digit. If not, immediately disconnect power and check for errors such as reverse polarity connection of power or incorrectly placed components.

When the circuit is operating, the supply to each IC should be 8V. You can check this by connecting one side of your multimeter to the ground PC stake and measuring pin 16 on IC2-12, IC14 & IC16; pin 14 on IC13 & IC15; and pin 8 on IC1.

You can set the DIP switches according to Tables 3 & 4 to suit your application. Note that at least one switch must be set to ON or the programmable divider will not operate. Note also that either LK1 or LK2 must be present on the board (but not both), otherwise IC5a will malfunction.

You can check that the tachometer operates by applying a signal from a function generator to the input. You may need to use the low signal input for this. Alternatively, simply pulling pin 9 of IC2 to 8V will cause the PLL oscillator to run at maximum and so display a reading.

Test that the display dims when the dimming input is connected to 12V.

Vehicle installation

The tachometer can be installed into a vehicle using automotive connectors to make the connections to the ignition positive supply, the lights circuit for dimming and the coil terminal. The ground connection can be made to the chassis with an eyelet and self-tapping screw.

Where access to the coil primary is impossible with the modern style of combined coil and transistor, you can pick up a suitable signal from the tachometer output lead of your engine management computer. The signal connects to the low signal input. It is calibrated as normal, taking the number of engine cylinders into account.

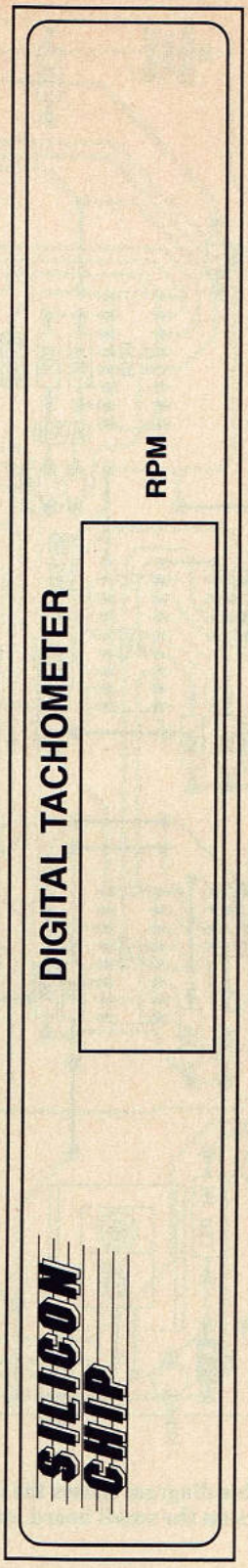


Fig.7: this full-size front panel artwork can be used as a template to make the cutout for the LED displays.

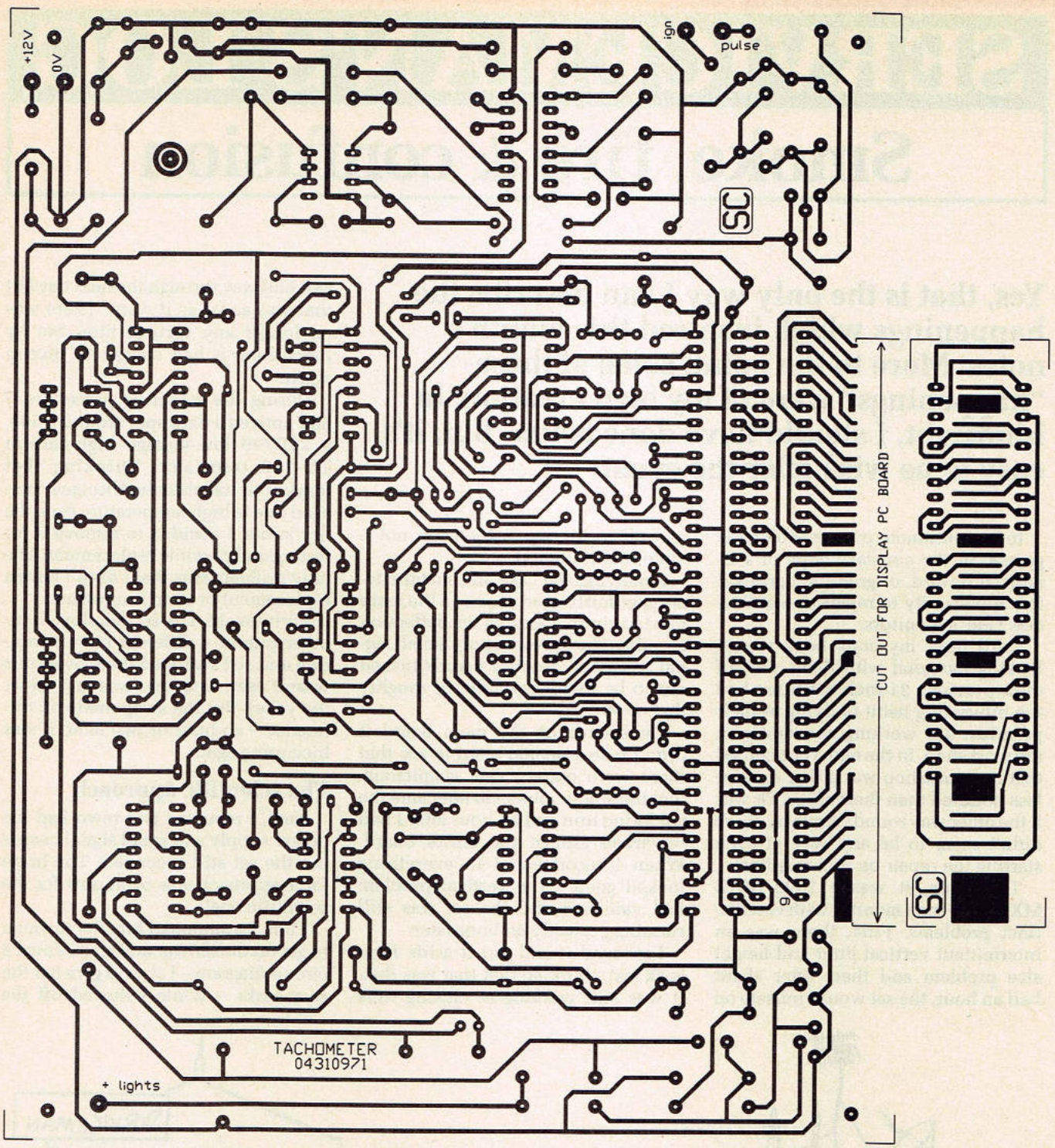


Fig.8: this is the full-size etching pattern for the two PC boards.

In some installations, it may be easier to keep the main PC board separate from the display board and connect with multi-way cable. This will allow the display to be mounted in a confined space.

If the tachometer is to be used on stationary machinery, a suitable shaft rotation sensor may be required. These are normally a metal vane with several notches which trigger a Hall effect switch or optical pickup.

Last digit lock

If you wish to lock the last digit on zero to prevent it continuously fluctuating, the PC board will require a small modification. Pins 3 & 4 of IC8 should be disconnected from the +8V supply using a knife to break the track in the thinned out section. Then make a solder bridge from the track leading to pins 3 & 4 to the ground at pin 8.

Finally, break the track leading to the "g" segment of DISP1 in the thinned section under the seven 680Ω resistors. **SC**

SERVICEMAN'S LOG

Smoke, fire & confusion

Yes, that is the only way I can describe the happenings which inspired this month's notes. More to the point, some of these "happenings" were of my own creation; in hindsight, I should have done better. But, it's easy to be wise after the event.

In the continuous pursuit of brownie points, in the constant hope of a financial reward, or gratuity, I grasped the opportunity to repair one of SILICON CHIP's monitors.

Until now, my copy book wasn't looking too good with them. One of their previous 21-inch monitors had the infuriating habit of dying at their premises but working constantly in my workshop. In the end, I concluded that my workshop was either drier or less polluted than their office. Or was it the other way round? Anyway, there didn't seem to be any way of even starting the repair on that monitor.

This time, it was a 1993 MAG MX17F 17-inch monitor with two distinct problems. First, there was an intermittent vertical jitter and height size problem and then, after about half an hour, the set would pulsate on and off in hiccup fashion (oh no! – more intermittents).

Removing the case and metal covers gave fairly good access to the main printed circuit carrying the deflection circuits. The power supply, small signal and RGB circuitry boards turned out to be less accessible, in roughly that order.

On examining the main board it didn't take a mental giant to see that there were quite a few suspicious-looking solder joints. So out came the soldering iron and an hour later I had reworked almost the entire board. When I reconnected it, everything looked good – the vertical problem had vanished and the set was still running perfectly an hour later.

I reboxed it and put it aside for a soak test, thinking that that was that. It was still working at closing time and half way through the next day but that was as far as it went. There was no longer any vertical jitter but by lunchtime, it had started to hiccup again.

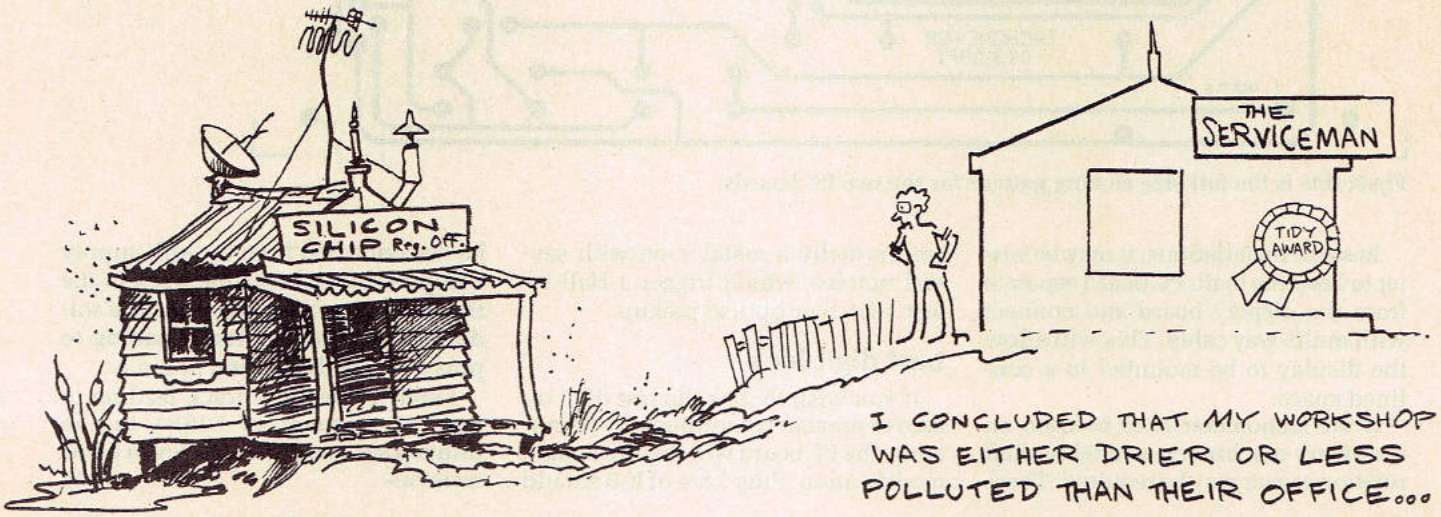
During the soldering procedure, I had noticed a dark spot around Q506, a 2SD799 low-voltage high-current TO-220 transistor. Thinking that maybe this transistor had become damaged due to high temperature from the dry joints, I decided to remove it for testing and possible replacement. The only problem was that I didn't have a replacement or even a substitute.

Fortunately, the set employed another one in a different circuit location and so I swapped them over (this wasn't easy, as access was just under the yoke). But the swap made no difference – an hour or two later, it was hiccuping again.

The scientific approach

Next, I removed and reworked the power supply and small signal boards but the set still hiccuped. The brute force approach was over; now for the scientific one!

First, I summoned Mrs Serviceman to get on the blower and track down a circuit diagram – I always give her the easy tasks – while I dusted off the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THE SERVICEMAN
TIDY AWARD
I CONCLUDED THAT MY WORKSHOP WAS EITHER DRIER OR LESS POLLUTED THAN THEIR OFFICE...

I SUMMONED MRS SERVICEMAN TO GET ON THE BLOWER & TRACK DOWN A CIRCUIT DIAGRAM

multimeter and warmed up the CRO. As it happened, she quickly traced the agency but that was as far as it went – the company wasn't prepared to supply a circuit diagram which meant that I was on my own unless I could score one from somewhere else. But for now, I decided to let it ride while I delved deeper into the monitor.

I was waiting for it to warm up when the phone rang and I had to deal with an elderly lady trying to book in a TV repair at home. It took some time to get all her details, the type of set, the fault, the likely costs involved and make an appointment. By the time I finished, there were two people queuing at the counter. And then the phone rang again.

All in all, by the time I dealt with everything it was over half an hour and when I went back into the workshop, the monitor was well and truly hiccuping. More precisely, this showed up on the supply rails which were pulsating in sympathy. In particular, I wanted to measure the 185V rail (the only voltage that wasn't fluctuating was the 325V to the main electrolytic from the bridge rectifier). I also needed to figure out whether the hiccuping was due to an abnormal load, a safety circuit, or an excessively high voltage rail.

I let everything cool and tried again and, as luck would have it, the fault was now permanent – it was hiccuping whether it was hot or cold and regardless as to how long the set had been running.

Next, I shorted the horizontal output transistor's base to its emitter and hung a 100W load on the 185V rail. It was still hiccuping. I then tried varying the input voltage with the Variac but it was a switchmode power supply that gave all or nothing. However, there was one thing – as the analog multimeter was swinging up and down, I noticed that the needle seemed to overshoot past 200V, although this might have been due to lack of damping in the meter.

I marked the position of the 185V setup pot (VR303) and then adjusted it. Interestingly, the set stopped hiccuping when I reached the lower end stop of VR303. Bingo! – it meant that this rail had to be too high.

Circuit tracing

My next step was to trace out the control feedback circuit – see Fig.1. This showed that VR303 was fed from the 185V rail via R331. The voltage on the wiper of VR303 then biased regulator IC303 which in turn fed optocoupler IC302 in the switchmode power supply primary.

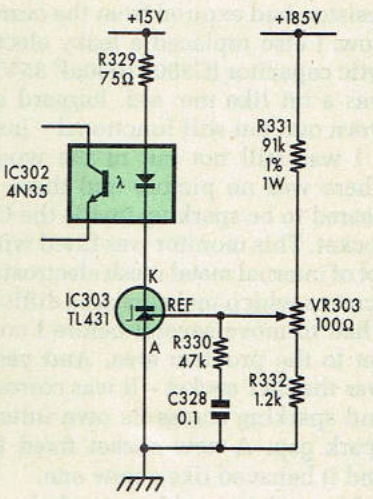


Fig.1: the voltage control feedback circuit in the MAG MX17F computer monitor.

Resistor R331 was a 1W unit and, when I removed the brown glue that was covering it, I found that it was slightly discoloured. So, were its colour markings correct? It was now nearing closing time and I was about to shut the shop but I was eager to prove that I was on the right track. I read from left to right – brown, red, black = 12Ω and quickly fitted a new one. Big mistake! The set tried to start, there was a crack – a puff of smoke – and *WHOOPS*!

It was too late to investigate further. I had to leave it; there was some (supposedly) important engagement or other for which I had to be on time – a wedding anniversary or something.

It wasn't until next day that I realised my folly. Initially, I had noted only the first three bands but there were actually five equally spaced bands – which I read as brown, red, black, brown and white. And the multimeter read 118kΩ. So was it really a 120kΩ resistor and had I misread the third colour, or had it been changed due to the brown goo or heat?

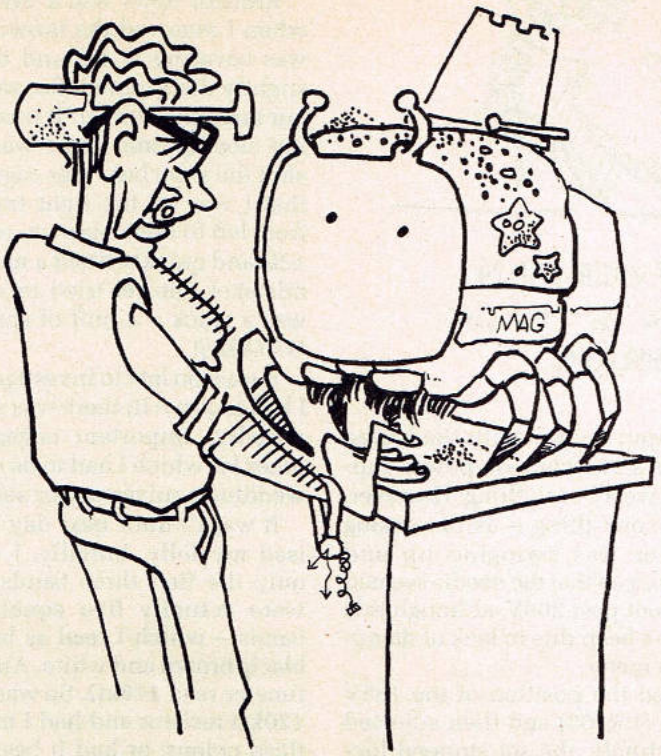
But this didn't make sense either. It was the white band that shook me out of my lethargy. As I had read it, the white band would be in the tolerance position. But there is no white tolerance band in the resistor scale. I had read the colours in the wrong order – the correct sequence was white, brown, black, red, brown. And that worked out to 91kΩ, 1%.

So the multimeter reading of 118kΩ was correct; the resistor was originally a 91kΩ device but had gone high, to 118kΩ.

This meant that the 12Ω resistor I had fitted was singularly inappropriate; as testified by the fate of IC303, which now consisted of just three legs sticking up out of the board. It took some time to find the rest of it in order to determine its type number. It turned out to be a TL431.

I fitted a 91kΩ resistor for R331, replaced IC303, reset the pot to the mark I had made, connected a digital multimeter to the 185V rail, and gingerly switched on. The set functioned correctly and the rail was almost spot on 185V.

Finally, I rehoused the chassis and put it aside for a long soak test, while trying to ignore the "was it ready?"



THE MAG CAME FROM NEAR THE BEACHES...

pleas from SILICON CHIP – I wanted to thoroughly test it. It went back a few days later and hasn't missed a beat since.

Now, about that, er, possible emolument arising from previously mentioned brownie points. No? I thought not. Oh, well.

Two more monitors

Surprisingly, the same week I had two other monitors in for repair. They were similar but dissimilar, if that makes sense. One was a 1993 MAG LX1564 and the other was a Magtron BMC-14SV4. They were similar in that the badges were the same font, size, and colour. The other similarity was that they were both dead due to corrosion. However, their chassis were completely different.

The MAG came from a location near the beaches, was corroded by salt air and in serious trouble. The power supply was blown and had to be rebuilt component by component. The faulty items were: F301, 3.15AT fuse; Q301, 2SK955 FET; IC301, CS3842A IC controller; and ZD307, 18V zener. Once the power supply was working, it went into hiccup mode – like the previous MAG monitor. Interestingly, it used the same main rail regulation circuit and the same resistor but in this case the cause was a short circuit horizontal output transistor (2SC4747).

By the time I found this, R153, a 1Ω resistor, had expired from the current flow. I also replaced a leaky electrolytic capacitor (C330, 1000µF 35V). It was a bit like me: old, haggard and worn out, but still functional – just!

I was still not out of the woods. There was no picture and there appeared to be sparking inside the CRT socket. This monitor was fitted with a lot of internal metal mesh electrostatic screens which makes access difficult. I had to move several before I could get to the problem area. And yes, it was the CRT socket – it was corroded and sparking across its own internal spark gap. A new socket fixed that and it behaved like a new one.

I haven't been able to track down a circuit for this model either. I would have liked to have known how to set up the HT and EHT rails, as nothing was marked. After such major surgery, I felt that it should have been checked. Anyway, at least it performed well after a prolonged soak test.

The Magtron was made by AVAT, which stands for Advanced Video and Audio Technology Co. It complies with a newish Swedish safety standard (MPRII) for levels of magnetic and electrical radiation, which it proudly boasted on the front.

Anyway, this was severely corroded by, of all things, coffee being poured into it. However, the damage was localised and it didn't take much to clean up the mess. The reason it was dead was because D515 was short circuit and C527 had exploded. Apart from that, it worked well when the work had been completed.

The ancient Sanyo

Now for a change of scene – TV sets. Mr Woods is a long standing customer of mine who owns a number of sets in a large rambling 2-storey house. Unfortunately, the house is on the side of a hill; worse still, all his sets are 63cm models.

The one he wanted me to look at was an ancient Sanyo CTP8631N employing a B7PJ chassis, though this is probably irrelevant for this story. He said his grandchildren had come down for the weekend and jumbled up all the stations. What's more, the video would not work.

He implied that all that was needed was a retune. Quick and easy – now where have I heard that before?

I arrived that afternoon and climbed, thankfully, only two flights of stairs to their rumpus room. The TV set sat in a rather dark, damp-looking corner. I switched it on and noticed that the touch sensors wouldn't change channel nor was there any picture. In fact, I was just pointing this out when there was loud banging from the rear and bright flashes of green raster on the screen.

I switched off immediately and asked Mr Woods if this the simple fault about which he was complaining? Well, actually it was – except it hadn't made that banging noise before!

I turned the set around and carefully removed the back. One has to be very careful with some Sanyo models; the heavy back can fall and take the neck off the tube in one quick guillotine action. This model was OK and

once inside I could see that it was very damp and obviously tracking from the ultor cap.

As my CRC 2-26 contact cleaner/lubricant was in the car way down the street, I asked if he had anything similar handy. The best he could suggest was some WD40. Close enough, I thought – it would do.

I sprayed the touch sensors, ultor cap, EHT transformer and tripler, then wiped up the excess where I could. When I switched on again, the channel selector worked and there was no more banging. But there was still no picture and I could hear hissing and spluttering noises from around the EHT transformer. I turned the set off and sprayed more WD40 in that area.

Another big mistake: I switched on again and stuck my head in the back, trying to pinpoint the sparking which I could still hear. Then there was a loud clicking noise and a flashover near the EHT transformer connections. The WD40 ignited in huge ball of fire and I nearly lost my eyebrows and what hair I have left.

The area had been fairly saturated with WD40 and it continued to burn with 30cm long yellow flames which showed no signs of extinguishing. I realised I had only a few seconds before the wooden case might start to burn too and cause a major disaster. I switched the set off quickly.

There was nothing to hand except a large rag which I grabbed and attempted to smother the flames. In what seemed like an eternity, I finally put the fire out and then turned around aghast to see that Mr Woods had watched the whole saga. He was far less concerned about it than I was.

I think many people would have abandoned the situation there and then but I figured that if I did that I would be letting Mr Woods down as well as myself – like falling off a horse, you should get back on immediately to restore your self-confidence. Or so I'm told. In practice, I play it safe; I don't get on horses. The trick was to pretend that it was all quite normal.

The melee had lasted, perhaps, only 10 seconds but I had at least seen where the fire started. I pulled the chassis out and unscrewed the EHT transformer. This transformer is fitted with terminal pins (or "posts"), which protrude vertically in a semicircular array from a plastic support above the main winding assembly.

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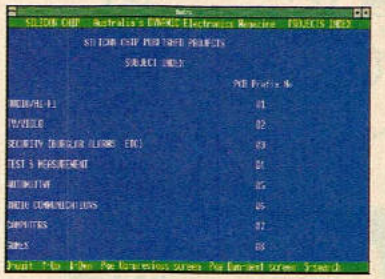

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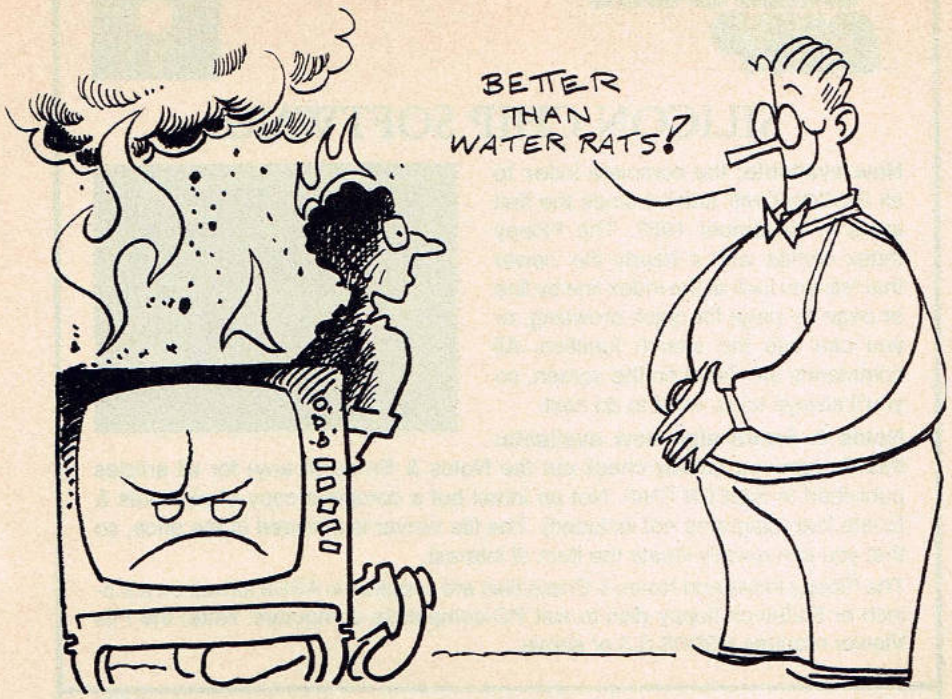

I WAS AGHAST TO SEE THAT MR WOODS HAD WATCHED THE WHOLE SAGA...

These terminals are supply points for the various voltage leads leading to other parts of the circuit. They are fed, in turn, by short bare wires emanating from within the transformer. And one of these short wires – the one connected to the G2 (screen) terminal – had corroded and broken, creating a gap across which some 500V was producing a spark. And it was this spark which had ignited the WD40.

With some difficulty, due to the short length of wire and the restricted space, I managed to solder a jumper across the gap.

There was now no need to wipe away excess WD40 because the heat had evaporated it along with any moisture and I was confident there were no more sparks to ignite it in any case. Nevertheless, I was nervous when I switched the set on again. It was all an anticlimax – both picture and sound were fully restored, much to my relief. The various stations could now be tuned in correctly with their corresponding touch button numbers and even the video functioned.

The fire area looked rather messy, with molten plastic leads and fittings, but I checked that their insulation was still OK and nothing was likely to short. After I had replaced the covers and put the set back, I explained the situation as best I could. I advised him that this damp corner was not the best place for it, that he shouldn't leave the set on unattended, and that he should have some sort of fire appliances inside his house anyway (smoke detectors, fire extinguishers, etc).

Finally, I emphasised that the set was old and corroded and really should be replaced. I didn't dwell too much on the flammable qualities of WD40 and left while the going was good and my reputation still intact.

My final faux pas

My final faux pas for this week – did I really need that many? – involved a Sony SLV-X57AS video recorder which came in with the fault "too fast". More exactly, when playing a tape the horizontal hold was off speed and speech was fast, rather like slow Donald Duck. Both the capstan and drum motors were running fast and the auto-tracking was not working. I removed all the covers and the front panel and examined the set carefully all over. It looked fairly new and in good condition.

I refitted the control knobs and switched on. According to the service manual, all the pulses in and out of the servo/system control (IC501) were at incorrect speed. These included the drum FG, PG and capstan FGs, as well as the control pulses from the ACE head and the outputs to the motors.

I noticed that when I touched pins 7 and 6 of IC403, the drum motor could be slowed until the picture was locked. IC403 is the error integrator.

I checked all the supply rails and "scoped" them for ripple, in case some of the electrolytics had gone in the power supply. All were present and correct. I then changed IC403, IC406, IC407 and was about to change IC405 before even trying to change IC501, a 100-pin surface-mounted high-density microprocessor. But by now I was beginning to smell a rat.

The machine was in good condition and no-one had fiddled with it – or so I was assured. What drastic action could have caused this? Well, I had to order these two ICs and they were expensive. In the meantime, I would have to put the machine aside and so, rather than risk losing the screws, I decided to reassemble the whole thing.

Fitting the front panel is a little fiddly, especially with the toggle control knobs and switches, but at least I had the whole thing back together. I was checking it to make sure I had done it all properly when I noticed a switch under the front panel, marked "Color System NTSC PB on PAL TV". It was in the wrong position but I didn't put any significance on this; it can easily happen when refitting the front panel. Instead, I simply moved the switch to its correct position and switched on for a check.

However, when I pressed play, the picture from the tape came up perfect in all respects. Suddenly all was clear. This recorder is a dual-standard machine; it will play either an NTSC tape or a PAL tape into a PAL receiver and someone had inadvertently moved the switch into the wrong position.

So much for my high-tech approach. I had found the fault and fixed it unwittingly – if only it hadn't taken so long for me to wake up to it! **SC**

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Two models available, ideal for use with home security systems as an indoor siren. Try being in the same room as one of these beasts in full song! Piercing two-tone warble at up to 102dB@1m.

A fantastic bargain at over 50% OFF!

SAVE OVER 50%!

S 6135 6-15VDC Siren Was $19.95, Now **$9**

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24V / 240V 500W Sinewave Inverter
with Battery Charger

Ideal for sensitive devices such as computers and televisions

Sinewave inverters are ideal for powering equipment which is sensitive to the waveform of its mains supply. Devices such as some televisions, data logging equipment, monitoring stations, computers, digital clocks and more can all be affected by variations in mains frequency, waveform and voltage. Sinewave inverters will run fluorescent lights where many square wave inverters won't. This inverter provides 500W of 240V sinewave power from a 24V DC supply. i.e. 2 x 12V car batteries wired in series. It also has a battery charger to maintain the batteries when connected to the mains, and can be used in two modes, inverter only, or battery charger. The inverter can be configured to start up automatically when mains power to its input socket fails.

M 8100 Normally $739, October SUPER SPECIAL **$599**

Mini Drill Set

A fantastic addition to any hobbyist tool kit, this powerful mini drill comes with a plugpack adaptor, four grinding stone bits, a cutting disc, four chucks (0.5, 1, 1.5, 2.4 and 3mm) and 5 PCB drills (0.5, 0.8, 1, 1.2 and 1.5mm). Features rocker switch activation and easy release chuck mechanism. Great for drilling and trimming PCBs, engraving your valuables, model making, polishing gems or jewellery, custom instrument panel work etc.

Includes 4 chucks, 5 drills, 4 grindstones, a cutting disc and even the plugpack!

T 2300 Normally $59, NOW **$49**

1500W Switchmode 12V / 240V Inverter

Modified sinewave circuitry! Can power flouro lights & microwaves!

This inverter provides up to a massive *1500W* of 240V power from a heavy duty 12VDC car or truck battery. Switchmode circuitry eliminates bulky and heavy output transformers, making this unit very lightweight compared to similar inverters. It's suitable for a wide range of applications such as remote homes, sail & power boats, building or mine sites, off road vehicles, caravans, farms etc. **Features:** • Over temperature & overload shutdown • **Auto fan cooling** • Low battery warning & shutdown • **Heavy duty leads** • Twin outlets • Weighs only 3.6kgs

M 8140 Normally $995, NOW **$795**

125W Mini Inverter

This amazing inverter provides up to 125W of 240V AC power from your car cigarette lighter socket! During our testing, it ran our entire A/V room setup, including a huge 68cm television and surround sound amp! Can power televisions, VCR's, lights, small battery chargers, shavers and hi-fi systems. Features low battery indicator, thermal & overload shutdown and is totally silent when operating. Built-in 3-pin plug (no adaptor required). Includes car cigarette lighter socket lead.

"There are quite a few different 12V to 240V inverters on the market, but few are as compact and as neatly packaged as this one" Silicon Chip, April '97

M 8105 Normally $129, NOW **$99**

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100m Rolls.
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Digital Multimeter

With Capacitance, Transistor Hfe and Temperature Ranges.

FREE PROTECTIVE HOLSTER!

This multimeter features a large 3.5 digit LCD display, and has a suite of useful features. Ranges include Capacitance up to 2000µF, Resistance to 200MΩ, Transistor gain, DC Volts and Amps, AC Volts and Amps, and even a Temperature range with the 'K' type thermocouple. It also has a 15 minute auto power off to prevent flattening the battery when you forget to turn it off! Measures DC resistance to 200MΩ and DC current to a huge 20A.

Includes test leads and K-type thermocouple!

Q 1060 **$89**

FREE SUPER BONUS!
Buy a Q 1060 DMM and receive a Q 1087 protective holster, valued at $12.50 FREE!

Professional 5 Sector Digital Alarm System
with Auto Dialler

Improve the security of your home or business with this microprocessor controlled alarm system, and get $100 worth of accessories FREE!!

This system is the same type as used by many commercial alarm companies to protect both residential and business premises across Australia.

Incorporating an inbuilt ***Austel approved*** auto-dialler, this alarm can be configured to automatically dial two preset numbers in the event of an alarm, i.e. it could ring a neighbour or alarm monitoring company. The main controller circuitry is housed in a sturdy steel cabinet, which can house an optional back up battery if required. The keypad control unit is generally located at the front door for easy access to arming and disarming of the system. The entire system is controlled and programmed via this keypad. A combination of normally open and normally closed sensors can be used on any zone. **Features:** • master code and three adjustable user codes • monitor function which tests battery backup and mains failure • four sectors with programmable attributes plus 24Hr zone • extensive noise protection circuitry and end of line resistors for added security • once triggered the alarm has the option of a silent alarm plus dialout • quick arming option • zone bypassing for sectors which are false triggering • bell test - to test the external sirens without dialling out • door chime mode for entry/exit paths • battery backup • home or away operation • accessible alarm memory for confirming which sectors were triggered • separate instruction and installation manuals • 12 months warranty

S 5490 **$279**

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Buy a set of 4 & SAVE!

Incorporates a pulse count circuit to minimise false triggering, "sense" LED, tamper switch and relay output. Range up to 12m horizontal when mounted 2m from the floor, with a 90° detection angle. Coverage can be changed by sliding the PCB up or down in the case. Can be configured as Normally Open or Normally Closed with . Suits the S 5490 alarm or many other security systems.

S 5315 Was $49, NOW **$39**, or Buy 4 for **$140**

6 Core Security Cable

W 2356 **$1.30** per metre
or **$170** 200m Roll

NB: 200m is enough to wire an average four bedroom home

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S 5460 **$28.95** ea

Super Bonus Deal!

Purchase a S 5490 5 Sector Alarm system before October 31st, and we'll supply *$100* worth of accessories

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(See EA Aug '97) A flexible circuit that provides preset voltage output of 3, 5, 6, 9 or 12V DC. Suitable for powering a wide range of DC low power circuits, such as running a personal CD/radio from a car cigarette lighter or powering external peripherals from a PC. Designed with the experimental hobbyist in mind the regulator can be changed with the moving of a jumper shunt connector, it's that simple. Can deliver up to 1.5 A depending on heatsinking.

Super Versatile circuit! Simply changing the pin header selects the output voltage. Up to 1.5A capacity!

K 3220 **$6.50**

NEW!

500W Amplifier Module Kit

NEW!

MASSIVE 500W! Great for DJ amps, component subwoofers, instrument amplifiers, even PA systems!

(See SC Aug '97) ***What a Beast! 500W into 4 ohms!*** Just the thing to power dedicated subwoofers, DJ, PA or party amplifiers or the like. Silicon Chip claims It is the biggest amplifier ever published in a magazine and they would be right. *Features* • 500W RMS into 4 ohms , 278W into 8 ohms (-0.3dB @ 20hz and 20KHz) • Input sensitivity 1.43V (at full power into 8 ohms) • Distortion typical less than 0.01% • Signal to noise 117db un-weighted 122db A-weighted • Supplied with the PCB and the components to populate the board, requires a heatsink and power supply *(requires ±80V DC)*

K 5190 **$230**

5 Digit Tacho Kit

NEW!

At last! A useful digital tacho with super-fast update time and 1 rpm resolution!

(See EA Oct '97) A fantastic, high-tech addition to your car's dashboard. This 5 digit tachometer features a crystal timebase for super-accurate readings, a 0.25 second update time and a resolution of ONE rpm. It also has a dimmable display, leading zero blanking, last digit "0" lock (stops "rolling" display), and can read to 60,000rpm if required. Not even rotaries rev *that* high! Can be configured for ignition coil input (3V) or low level input (1V) from an existing tacho. If you're after a *useable* digital tacho for street or circuit applications, this is it! *Note: Case NOT included.*

K 4325 **$79**

Multi-Spark Capacitor Discharge Ignition Kit

NEW!

Provides multiple sparks for a cleaner, extended mixture burn, increasing power and efficiency!

(See SC Sept '97) Why multi-spark? Fuel burns more thoroughly with a multiple spark and can therefore improve engine performance especially in two stroke motors, older engines and high performance four strokes. The circuit also fires fouled plugs, thereby reducing the time between plug replacement. If you own a go-kart, why not boost it's performance with this circuit? • Operates on reluctor, points or hall effect signals • Regulated 300V output (constant spark energy) • Twin inputs for twin coil systems • Output for electronic tachometers • Usable to beyond 1000 sparks/second (equals 15000 rpm for V8) • Includes all parts except the pickup circuit. • Supplied in an attractive black powder coated metal- automotive project box

K 4370 **$110**

PC Stepper Motor Controller

Start experimenting with robotics! Allows accurate control over a stepper motor.

This kit allows control over a single stepper motor via the parallel port of a PC computer. Uses include control of robot projects or any other application where a precise number of turns or revolutions is required (with a little imagination and experimentation maybe a turns winder for transformers). Daisy chained together, control of up to eight motors is possible with one PC. Supplied in short form and requiring a 12V DC power supply this project comes with all the components and PCB to begin experimentation.

K 2835 **$32.50**

NEW!

Remote Control Volume Kit

Build it into an existing amp and control your stereo volume from the comfort of your armchair!

(See EA July '96) This kit uses an infra-red transmitter and receiver and a motor driven pot to enable you to control the volume of your amp or preamp from anywhere within 5m line-of-sight of the receiver. Build it into your home-built amplifier or preamp for a professional finish. Includes remote transmitter case.

K 5024 **$45**

Laser Transceiver Kit

NEW!

(See EA, Aug '97) Utilising a MAX232 IC and a clever little circuit to strobe the laser and interpret the received signal, this kit allows two computers to communicate over distances of up to 50m or more (depending on the laser used) via their RS232 ports. Supplied shortform with the components to build the transceiver. Laser pointer extra, see our A 0201, this month only $59.

K 2860 **$21.95**

Laser Transmitter Kit

(See EA, Aug '97) The transmitter can be used for light effects, one way (half duplex) communication with the PC and experimentation. With RS232 input and TTL input capability. Supplied shortform with components to build the transmitter only.

K 2862 **$15.95**

A 0201 Laser Pointer **$59**

Mini-Strobe Kit

NEW!

(See EA, Aug '97) Taking advantage of a new range of white LED's this mini strobe can be used to measure the RPM of any thing that rotates or moves. From 400 - 4000 RPM , the strobe rate can be increased until the object motion appears to stop, then the RPM can be read off the scale on the front panel. Supplied with a project box with silk screened front panel, the kit has provision on the PCB to expand with the addition of more LED's, variable pulse width and an addition to allow the measurement of pulse width on a frequency counter. Requires 9V battery (not included).

K 5785 **$21.50**

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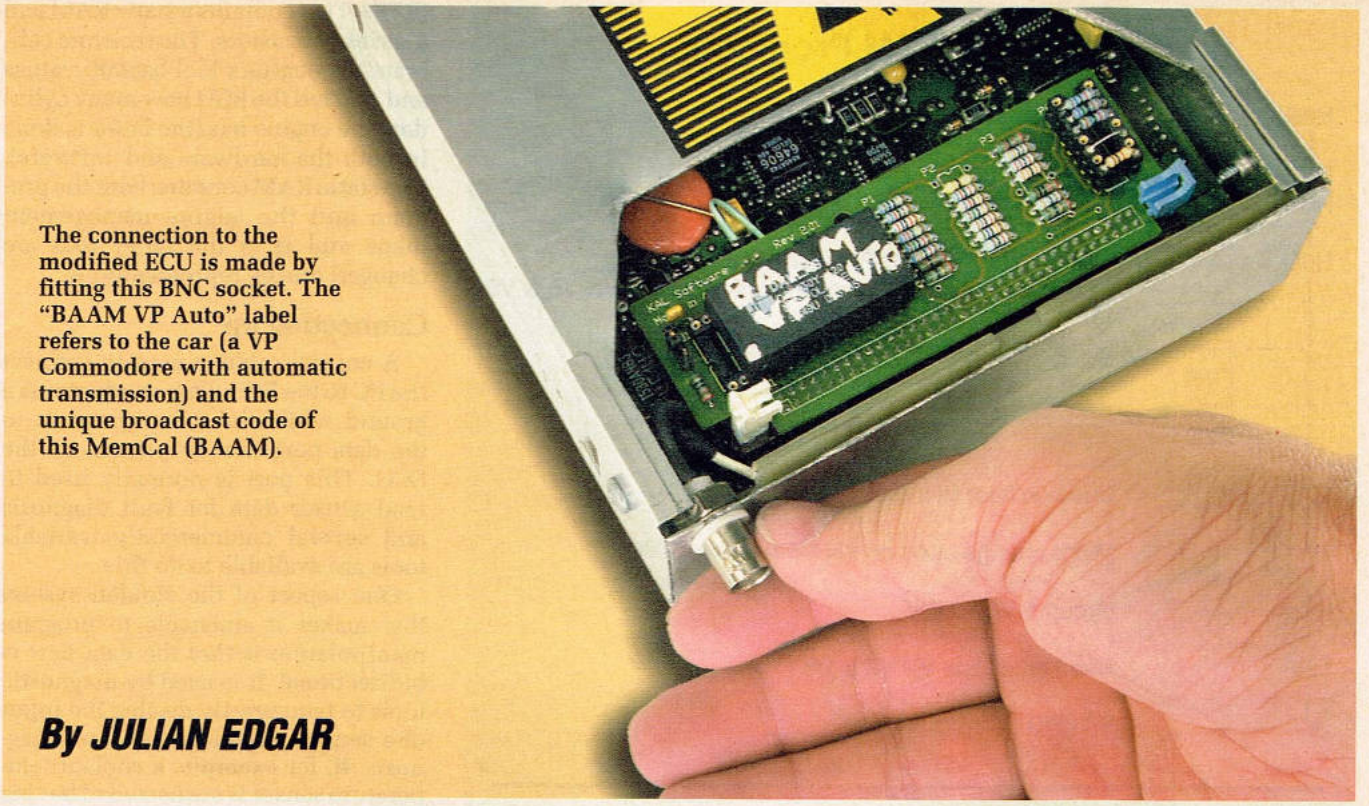


The connection to the modified ECU is made by fitting this BNC socket. The "BAAM VP Auto" label refers to the car (a VP Commodore with automatic transmission) and the unique broadcast code of this MemCal (BAAM).

By JULIAN EDGAR

Reprogramming the Holden ECU

Real-time reprogramming of Holden's ECU (electronic control unit) is now possible thanks to a very clever software package. It takes the guesswork out of optimising performance if engine modifications are made.

No major car company provides software that allows its engine management system to be reprogrammed. This means that anyone who is capable of reprogramming the main chip in the ECU has previously been involved in some clever detective work, to find out how it works!

Some aftermarket companies make chip changes on an experimental basis, altering a byte and then observing how the engine responds to that change. In that way, they gradually build up a picture as to which parts of the program control which aspects of the engine behaviour. A radically different approach has been adopted by Ken Young, the programmer behind the Kalmaker (formerly DynoCal) package. Ken has identified the function of each byte within the dozen or so programs used by Holden in its various ECUs and has written a software editing package to suit.

Basically, the Kalmaker software runs on a portable PC and allows real-time reprogramming of the Holden ECUs.

As indicated in the July 1997 issue, the Holden ECU is based on a MemCal. This is a plug-in module that contains an EPROM (for program and engine data) plus DIP resistor packs to provide engine fuel backup values. The rest of the electronics within the ECU module includes the injector drivers plus various counters, timers and so on, as required in any engine management system.

The EPROM in the MemCal is not amenable to byte-by-byte reprogramming. To get around this problem and to allow data changes "on the fly", the MemCal is replaced with a new PC board dubbed a "Real Time Board"

GMH 16K ECM Programs

H35	Base program used on 1.8l TBI Camira
H54A H54B	1.6l TBI + 1.8l PFI Pulsar/Astra 2.0l PFI Camira
H5D	Late 1.6l TBI + 1.8l MPI Pulsar/Astra? Late 2.0l PFI Camira, also VL Walkinshaw & VN V6 & V8
FVA FVB FVC FVD	Series of programs for Formula Brabham V6
HA5	Used on later VN V6 only
HB1	Minor change used on VN V6 & Group A V8
HDB	Group A V8 & HSV
HFB	Used on all late VP V6 & V8
H03	V6 LPG

GMH 32K ECM Programs

H12A H12B	VR 3.8l V6 & 5.0l Manual Transmission
H3C	VR 5.7l V8 Manual Transmission
H5B	VS 5.7l V8 Manual Transmission
H5A	VS 5.0l V8 Manual Transmission

GMH 64K PCM Programs

H11A H11B H11C	VR 3.8l V6 & 5.0l V8 with 4L60E
H2A	VR 3.8l V6 LPG
H3D	VR 5.7l V8 with 4L60E
H59	VS 5.7l V8 with 4L60E
H84	VS 5.7l V8 with 4L60E 96 transmission update
H58	VS 5.0l V8 with 4L60E
H83	VS 5.0l V8 with 4L60E 96 transmission update

Fig.1: a number of different ECU programs have been used by Holden over the years. Each of these needs a script containing data addresses and other information purpose-written for it.

(RTB). This contains a static RAM and a series of resistors. The resistors calibrate the engine's fuel backup values and also tell the ECU how many cylinders the engine has (the latter is done in both the hardware and software). The static RAM contains both the program and the engine management maps and it is the latter that are changed during reprogramming.

Connecting up

A coaxial cable is used to connect the PC to the ECU. One conductor is a ground while the other connects to the data port already present on the ECU. This port is normally used to read sensor data for fault diagnosis and several commercially-available tools are available to do this.

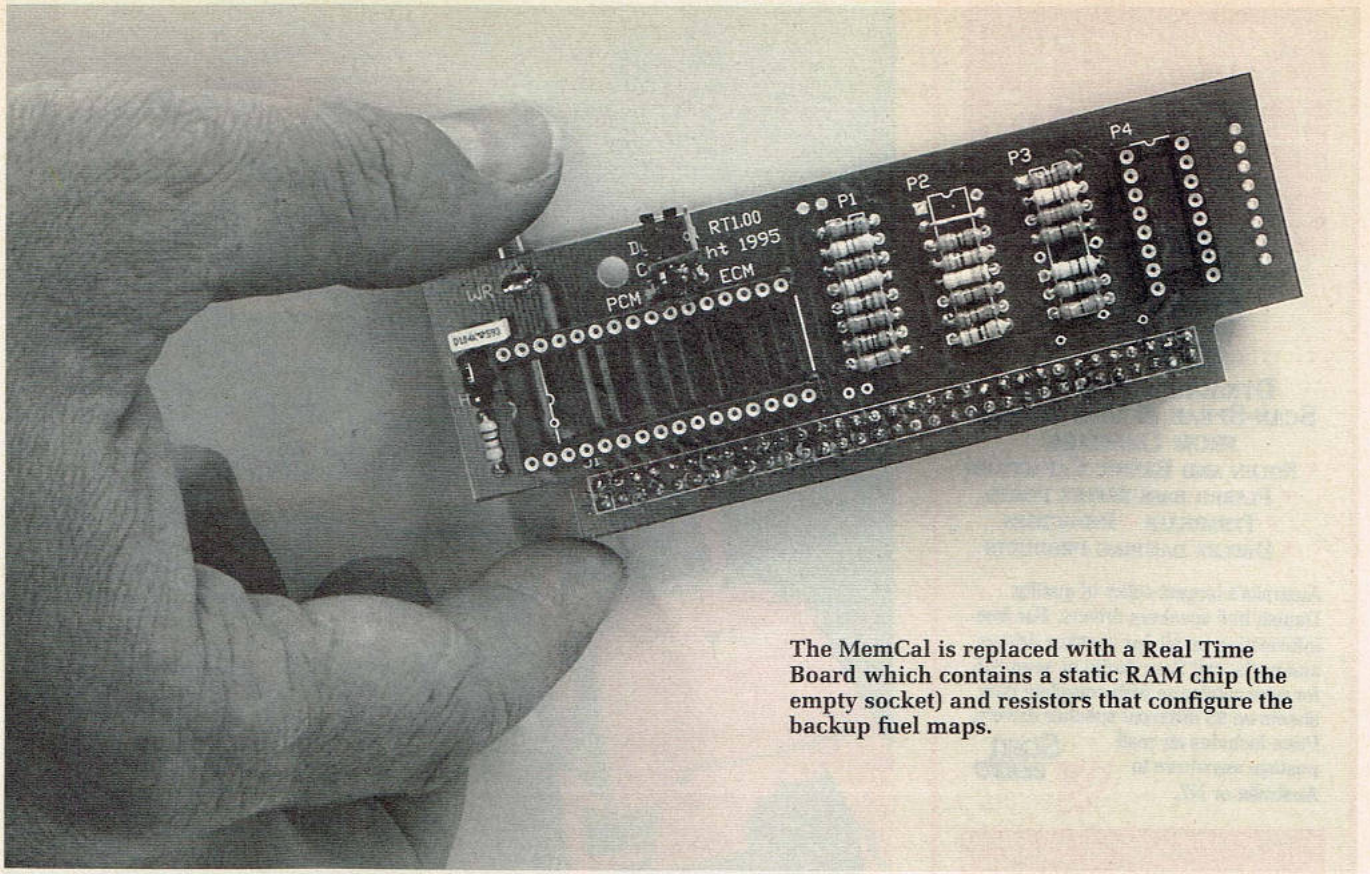
One aspect of the Holden system that makes it amenable to program manipulation is that the data port is bidirectional. It is used by diagnostic tools to temporarily disable the input of a sensor, allowing easy fault diagnosis. If, for example, a coolant temperature sensor is suspected of having an open circuit in its wiring loom, it can be software-disabled and the resulting engine change studied. This bidirectional port has its origins in the US On-Board Diagnostics (OBD) legislation, which requires that vehicle emissions be kept within certain parameters for long periods.

The Kalmaker software modifies this facility, using it to write the transmitted data to the static RAM rather than just using it to disable a particular input sensor.

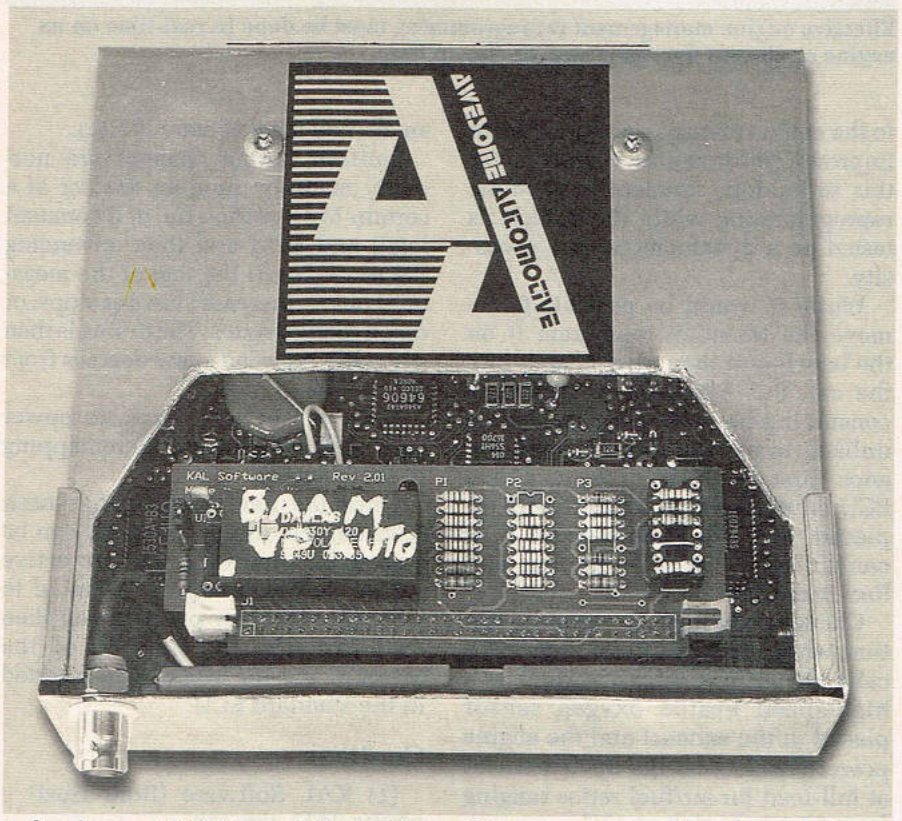
The program addresses are contained within the individual Kalmaker scripts. The Kalmaker program itself is just a general purpose editor; it's the scripts that contain all the intelligence and a script has been written for each of the different Holden MemCal programs. Fig.1 shows the different MemCals that have been produced over the years.

Note that there are often update MemCals within the one model. However, these only change the program data (rather than programming technique) so they don't need a new script.

Using the bidirectional port to write directly to the static RAM gives seamless changes in real time. This is important as sudden mixture or timing changes can be dangerous if the engine is being run under load on a dyno during the reprogramming.



The MemCal is replaced with a Real Time Board which contains a static RAM chip (the empty socket) and resistors that configure the backup fuel maps.



A development ECU is used during the real-time reprogramming. Once the program is correct, it is burnt into a normal MemCal's EPROM which is then re-inserted into the standard ECU.

Another approach used in some systems is to use an EPROM emulator in conjunction with a standard EPROM. Each time a data change is made by the emulator, the ECU toggles to the standard EPROM, covering up the data gap, so to speak. This can cause hiccups as the engine is momentarily run by a program that is no longer ideal for the operating conditions. It's for this reason that the Kalmaker program avoids this approach.

The serial data cable connects the PC's parallel port to the ECU via an interface board. The interface is needed because the ECU high speed serial data link does not conform to RS232 specifications and its baud rate is 8192, not the standard 9600. The interface board allows bidirectional communications via the PC's parallel port status lines. The PC can then poll the parallel port for incoming data in a similar fashion to Laplink's PC-to-PC communications software.

Reprogramming a Holden

If the engine has been modified or its operating parameters changed (eg, if premium unleaded fuel is always used), changes can normally be made

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Effective engine management reprogramming must be done in real-time on an engine or chassis dynamometer, as shown here.

to the engine management program to improve performance. However, for this to be done efficiently, real-time reprogramming while the vehicle is tested on a dynamometer is a necessity.

While it would be possible to remove the MemCal, reprogram it on the bench and then plug it back into the car, this approach is very time consuming because the changes are unlikely to give the optimum performance "first go". Instead, the complete ECU is removed and temporarily replaced with the development ECU containing the serial cable plug and Real Time Board.

Changes can then be made in real time while the car is under load. Typically, the air/fuel ratio is sensed by a high-speed heated oxygen sensor placed in the exhaust and the engine power checked on the dynamometer at full-load for air/fuel ratios ranging from 13:1 to as rich as 12:1.

Both the Commodore V6 and V8 engines develop maximum power at an air/fuel ratio of about 12.5:1.

Ignition timing changes are normally made by holding the car at a certain MAP setting (ie, at a constant load) and RPM and then advancing the timing until the rate of the measured power increase slows or stops, or detonation intrudes. The timing is then generally retarded a few degrees from this point.

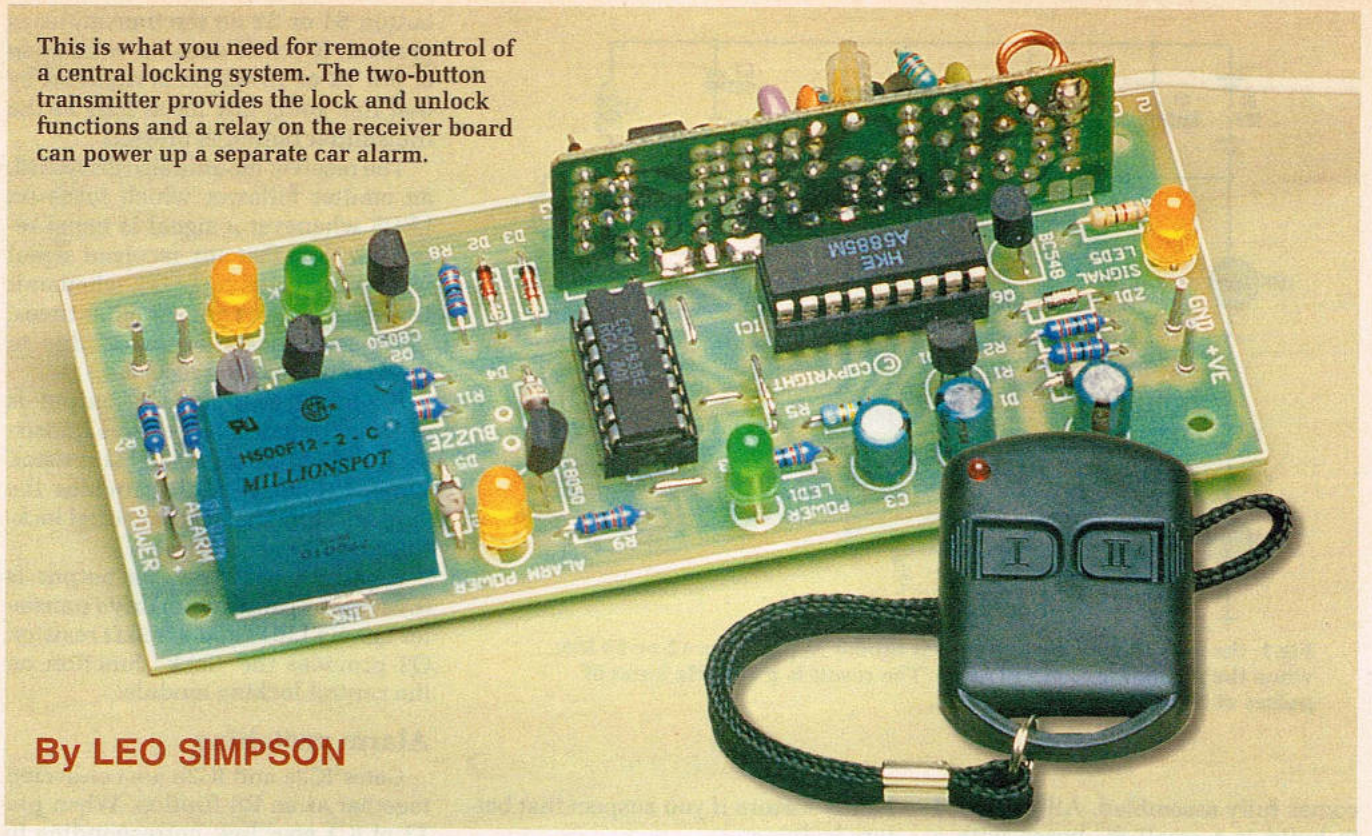
Note that in some cars, no power gain at all can be made by remapping in this manner.

Once the new program has been devised, the original program can be erased by removing the protective sticker and exposing the MemCal to UV light. The new program can then be burnt into the EPROM of the MemCal and the MemCal re-inserted in the standard ECU.

Contacts

(1) KAL Software (Brad Host) – phone 0412 266 758.

(2) Awesome Automotive – phone (08) 8277 3927. **SC**



This is what you need for remote control of a central locking system. The two-button transmitter provides the lock and unlock functions and a relay on the receiver board can power up a separate car alarm.

By LEO SIMPSON

Add central locking to your car

Don't you just envy those swaggering motorists who just park their car, get out and then walk away without having to lock the doors. They just blip their little key remote and the doors all lock themselves automatically. It's even better for them when it's raining. None of this fumbling with keys while you get drenched.

AS YOU CAN SEE, I get frustrated by motoring's little tribulations. It's even worse if you regularly drive two cars, one with central locking and one without (no, I don't mean at the same time). When driving the car without central locking, it's all too easy to walk away without locking the car. And then there are the times when you go to open the rear doors to get something off the back seat and the doors are still locked.

All of which is a pretty strong incentive to install remote central locking. It's stops you getting wetter in wet weather and avoids the possibility of strained fingers when trying to open locked doors.

Actually, adding central locking to a car doesn't require any electronics at all. All you need is a set of central door locking solenoids, a wiring diagram, a screwdriver, a free afternoon and a fair bit of patience. The tricky bit is where you have to thread the wires for the solenoids through the door pillars and so on.

But simply having central locking is not good enough because you still have to lock and unlock your car with a key. To be truly up to date you need one of those nifty keyring doodads and that's what this project is all about.

In essence, this project provides the UHF remote link; a keyring transmitter with two buttons and a UHF receiver board which operates the central door-locking solenoids. Actually, we should note that they are not solenoids but motor-driven actuators.

You don't need to assemble the circuitry of the keyring transmitter. It

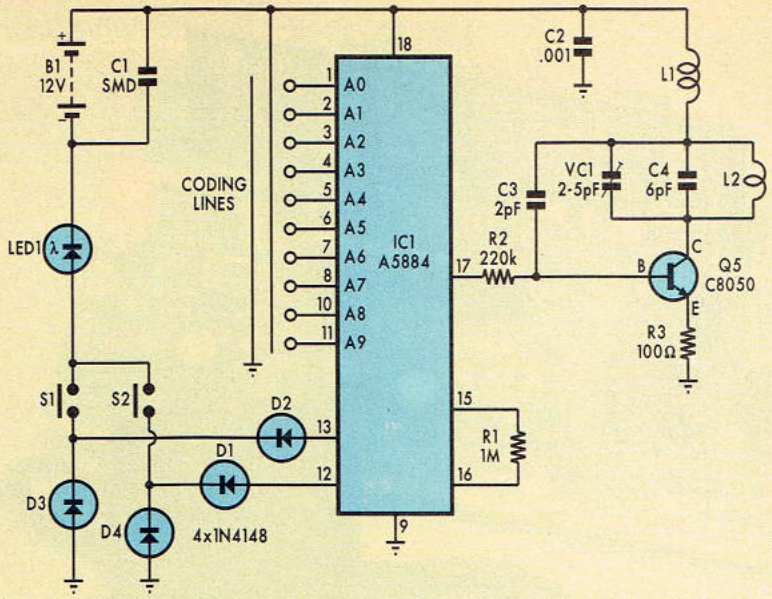


Fig.1: the 2-channel transmitter uses diodes to pull pins 12 or 13 low when the pushbuttons are pressed. The result is a 100kHz burst of pulses at 304MHz.

comes fully assembled. All you need to build is a small PC board with a preassembled UHF receiver module and a handful of other parts.

Transmitter circuit

Now while you don't have to build the transmitter since it comes ready built, it is useful to have a look at the circuit in order to understand how it functions. The transmitter circuit is shown in Fig.1. It shows an 18-pin trinary encoder chip, IC1, an A5884, It drives a single transistor connected as an oscillator which runs at 304MHz whenever pin 17 of IC1 goes high. The result is a 100kHz burst of encoded pulses at 304MHz which is radiated by the inductor L2, which is actually just a single loop of track on the PC board.

IC1 can deliver two separate encoded pulse trains, depending on which button is pressed. When either button is pressed, power is applied to IC1 via diode D3 or D4 while the encoding option is selected by D2 or D1 respectively. Note that there are many thousands of codes available depending on whether the address lines are tied high, low or left open circuit. That's where the word "trinary" applies, because there are three separate encoding options for each address line.

LED1 provides a visual indication that the transmitter is operating, a handy feature if you suspect that battery is dying.

A number of the components on the transmitter board are surface mount types so if you do pull it apart you will find that they are rather hard to see and identify unless you have a magnifying glass.

Receiver circuit

Fig.2 shows the circuit of the receiver board. This uses a small UHF receiver module to detect the pulses of 304MHz and turn them into a pulse stream which is fed into pin 14 of the matching trinary decoder chip, IC1, an A5885M. Depending on whether button S1 or S2 on the transmitter is pressed, IC1 will detect a valid code at pin 12 or 13 which is signified by that line going low for as long as the transmitter button is pressed.

This is what the transmitter looks like when you pull it apart. You will need to tweak the trimmer capacitor at the top of the board to set it to 304MHz.

The receiver module also drives Q6, an emitter follower which turns on LED5 whenever a signal is being received. Note that any received signal will be indicated by LED5, whether it is a valid code or not. At other times, LED5 may flicker on or off due to random noise being received.

If pin 12 goes low, its output is inverted by gate IC2c to drive transistor Q4 via LED3 and a 3.3kΩ resistor. When Q4 turns on it provides the "unlock" function on the central locking module.

If pin 13 goes low, its output is inverted by gate IC2d to drive transistor Q3 via LED4 and a 3.3kΩ resistor. Q3 provides the "lock" function on the central locking module.

Alarm switching

Gates IC2a and IC2b are connected together as an RS flipflop. When pin 13 of IC1 goes low, corresponding to button S1 on the transmitter being pressed, the flipflop is set, with pin 3 of IC2 going high. Being a flipflop, pin 3 stays high even after button S1 is no longer being pressed and it drives transistor Q5 via LED2 and the associated 3.3kΩ current limiting resistor. Q5 operates the relay to supply power to a car alarm, if you have one fitted. Hence this circuit can operate central locking and a car alarm if you wish.

When pin 12 of IC1 goes low, corresponding to button S2 on the transmitter being pressed, the flipflop is reset, with pin 3 of IC2 going low. This turns off Q5 and the relay, so that the car alarm is turned off.

Operating either of the buttons will cause diode D2 or D3 to conduct and turn on transistor Q2 which operates a buzzer. The buzzer is optional and probably not necessary for most applications.

Board assembly

Fig. 3 shows the component layout on the PC board. The board assembly is pretty straightforward but we would suggest that the PC stakes and links be installed first. Then insert the resistors, diodes, LEDs and electrolytic capacitors. Make sure that the polarised components are installed the right way around. Then insert the transistors and

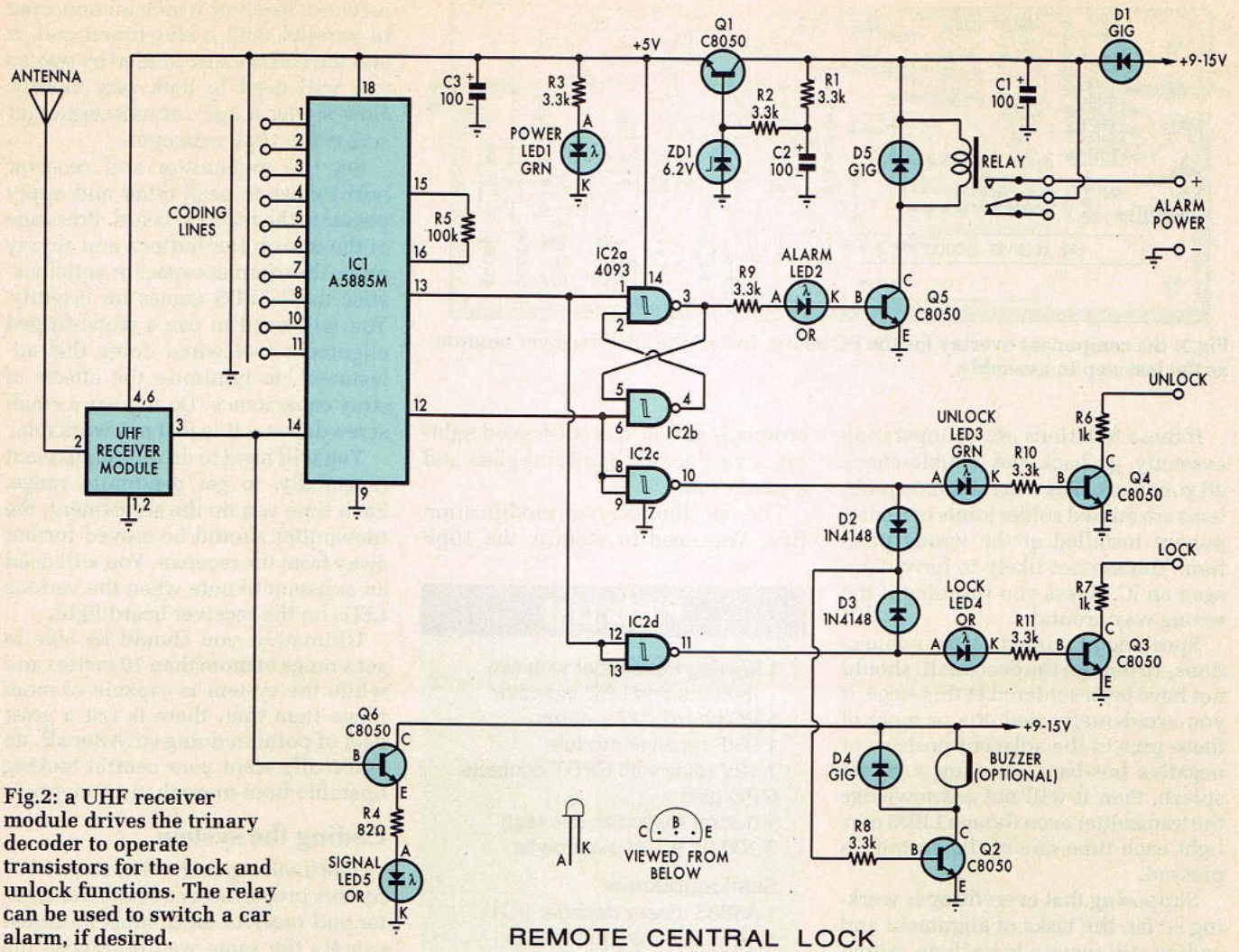


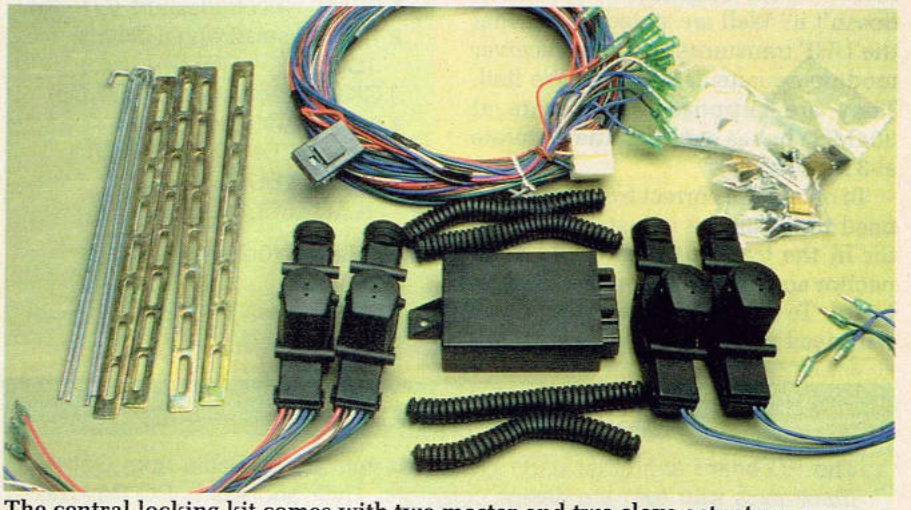
Fig.2: a UHF receiver module drives the trinary decoder to operate transistors for the lock and unlock functions. The relay can be used to switch a car alarm, if desired.

REMOTE CENTRAL LOCK

note that there is a trap for young (and old) players at this point.

We have seen these C8050 transistors supplied with varying pinouts. The board is designed to take transistors with the conventional EBC pin sequence, as shown on Fig.2. However they can sometimes be supplied with the ECB pinout sequence, so you should always check the labelling on the plastic encapsulation. If it is different, you will need to bend the transistors' pins to match the PC board.

Next, install the two ICs and then the receiver module. Do not solder the address pins of IC1; ie, pins 1-8 and 10 & 11. These may be soldered later when you custom code the transmitter and decoder. Check your work carefully against Fig.2 and Fig.3.



The central locking kit comes with two master and two slave actuators, a control unit, the loom and mounting brackets for the actuators. The control unit is linked up to the decoder board for full remote control.

Test & alignment

Now apply power from a 12V DC source and operate the buttons on the transmitter. Each time a button is pressed, LED5 (orange) should come on brightly. LED3 should light when button S1 is pressed and LED4 should light when button S2 is pressed. Furthermore, LED2 should light when S1 is pressed and go out when S2 is pressed, showing that the alarm functions are correct.

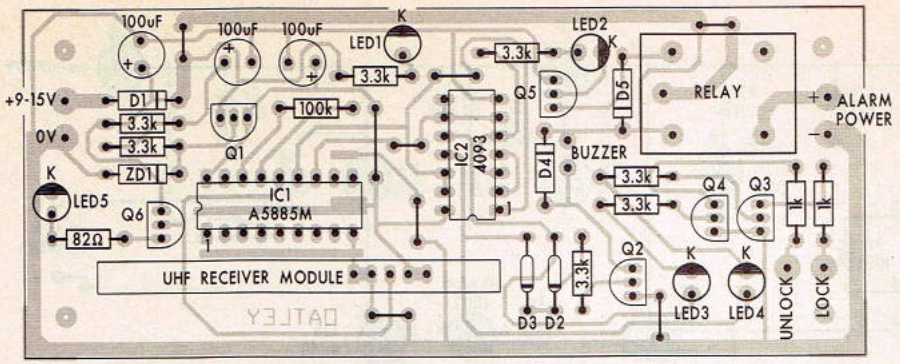


Fig.3: the component overlay for the PC board. Install the UHF receiver module as the last step in assembly.

If these functions are not operating correctly, go back and double-check all your work. The most common problems are missed solder joints or a component installed at the wrong position. You are not likely to have damaged an IC unless you installed it the wrong way around.

Speaking of missed solder connections, 10 pins on the decoder IC should not have been soldered at this stage. If you accidentally tied one or more of these pins to the adjacent positive or negative bus-bars, even by a solder splash, then it will not acknowledge the transmitter even though LED5 may light each time one of the buttons is pressed.

Supposing that everything is working so far, the tasks of alignment and coding still remain to be done. Alignment? What alignment? It works, doesn't it? Well we stated earlier that the UHF transmitter and the receiver module operate at 304MHz. We lied. They are supposed to operate at 304MHz but as supplied they operate at 318MHz.

To obtain the correct frequency, you need to tweak the adjustable capacitor in the transmitter and add a capacitor across the coil on the receiver board. To do both of these tasks, you will need super duper eyes with microscopic vision or at least, good lighting, a very good magnifying glass and a steady hand.

Let's do the receiver modification first. You need to identify the 10pF ceramic capacitor which is connected in parallel with a slug-tuned coil. It and the coil are surrounded by wax so you will need to look very closely. Now solder a 2pF ceramic capacitor across the 10pF capacitor.

Set the transmitter and receiver board close to each other and apply power to the receiver board. Press one of the transmitter buttons and slowly rotate the trimmer capacitor anticlockwise until LED5 comes on brightly. You will need to use a metal-tipped alignment tool when doing this adjustment, to minimise the effects of stray capacitance. Do not use a small screwdriver – it is just not workable.

You will need to do this adjustment repeatedly, to get maximum range. Each time you do the adjustment, the transmitter should be moved further away from the receiver. You will need an assistant to note when the various LEDs on the receiver board light.

Ultimately, you should be able to get a range of more than 10 metres and while the system is capable of more range than that, there is not a great deal of point in doing so. After all, do you really want your central locking operable from more than 10 metres?

Parts List

1 keyring transmitter with two buttons and LED indicator
1 PC board, 117 x 48mm
1 UHF receiver module
1 12V relay with SPDT contacts
6 PC pins
1 buzzer (optional; see text)
3 100µF 16VW electrolytic

Semiconductors
1 A5885 trinary decoder (IC1)
1 4093 quad 2-input NAND Schmitt trigger (IC2)
5 C8050 NPN transistors (Q1-Q5)
2 1N4148 small signal diodes (D2,D3)
3 GIG power diodes (D1,D4,D5)
1 6.2V zener diode (ZD1)
3 green LEDs (LED1, LED3)
3 orange LEDs (LED2,LED4,LED5)

Resistors (0.25W, 1%)

1 100kΩ	2 1kΩ
7 3.3kΩ	1 82Ω

Where To Buy The Parts

The PC board and other parts for this design are available from Oatley Electronics who own the design copyright. Their address is PO Box 89, Oatley, NSW 2223. Phone (02) 9584 3563; fax (02) 9584 3561. The prices are as follows:

UHF remote control with two-button transmitter $35
Additional two-button transmitter $15
Central locking kit, two masters, two slaves plus loom $60
Please add $5 for postage and packing.

Coding the system

The final step in the electronic work for this project is to code the transmitter and receiver. Both must be coded exactly the same way otherwise the system cannot work. If you connect pin 2 of the transmitter chip to 0V, then pin 2 on the decoder chip must also be connected to 0V.

Note that while the circuit of Fig.1 shows both positive and negative busbars for coding, and the same on Fig.2, the transmitter board actually only has the 0V track available for easy coding. If you want to tie some pins high, you will need to wire a small link on the back of the PC board. If you take this approach, you must be careful that the board can still sit flush in the bottom of its case. If it does not, you will not be able to close the case up without having one of the buttons permanently pressed.

Once the system is coded and operating as it should, it can be fitted into a case or a large piece of heatshrink tubing and installed underneath the dash panel of your car. Make sure the central locking system is working exactly as it should before hooking it up to the remote control receiver. SC

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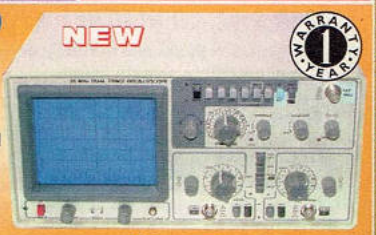

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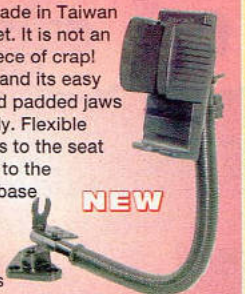

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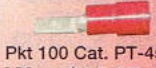

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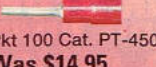

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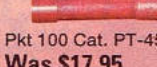
Now $8 Pkt

BULLET SPLICER



Pkt 100 Cat. PT-4528

Was $17.95

Now $10 Pkt

JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS

NEW MAINS PRODUCTS

SINGLE ARCHITRAVE SWITCH
Cat. PS-4050
$7.25

SIDE ENTRY 240V PLUG
Cat. PP-4001
$2.95

SINGLE WALL SWITCH
Cat. PS-4055
$7.95

DOUBLE WALL SWITCH
Cat. PS-4057
$12.95

CORDLINE SWITCH
Inline cord switch for 2 and 3 core cable up to 10A. Switches both active and neutral wires. Suitable for AC mains only.
Cat. PS-4075 **$11.50**

DOUBLE ARCHITRAVE SWITCH
Cat. PS-4052
$11.95

DOUBLE POWER POINT
Cat. PS-4060 **$16.90**

WALL PLATE MOUNTING BLOCK
Cat. PS-4062 **$4.50**

LARGE JUNCTION BOX
Cat. PS-4065 **$5.95**

FLAT DOUBLE ADAPTORS
RIGHT
Cat. PP-4035
LEFT
Cat. PP-4036
$2.95ea

GLOBE BATTEN HOLDER
Cat. PS-4070
$6.95

LIGHT DIMMERS
With small plate and switch Cat. PS-4082
$16.95
With large plate and switch Cat. PS-4084
$16.95

6 WAY SLIMLINE POWER BOARD
Cat. MS-4045 **$13.95**

EXTENSION CORDS
3.5m Long Cat. PS-4125
$5.95
5.5M LONG
Cat. PS-4130 **$7.95**

DIMMER ONLY
Ideal for mounting in a standard switch plate
Cat. PS-4080
$10.95

SWITCH POWER STATION
Each socket is individually switched, and there is an inbuilt circuit breaker.
Cat. MS-4050
$39.90

3 WAY AUDIO INPUT SWITCH
Supplied in a metal case, and has 3 sets of RCA sockets on the rear.
Cat. AC-1658
Was $27.95 Save $8
Oct. $19.95

MINI TOWER CASE
Includes 200W power supply. See 97 Cat. page 161.
Cat. XC-4635
Save $10
Only $79.95

MAIL ORDER POT SPECIALS NEW
We have a very small quantity of Pots available that were used in various old kits. Grab a spare while you can! Available from our Mail Order Dept. or from Rhodes store only.

Used In Playmaster 60/60 Amp

10K Centre Click Antilog Dual Gang	$2.50	Cat ER-4522
25K Centre Click Linear Dual Gang	$2.50	Cat ER-4524
50K Full Click Log Dual Gang	$2.50	Cat ER-4526

Used In Parametric EQ from Silicon Chip

25K Linear Dual Gang 16mm Spline Shaft	$2.00	Cat ER-4530
50K Log Single Gang 16mm Spline Shaft	$1.00	Cat ER-4532
10K Linear Single Gang 16mm Spline Shaft	$1.00	Cat ER-4534

40 PIECE TOOL KIT
See Cat. P99 for full list.
Cat. TD-2100
Was $24.95 Save $5
Now $19.95

100 PIECE TOOL KIT
See Cat. P99 for full list. Cat. TD-2102
Was $49.95 Save $10
Now $39.95

BOTH INCLUDE BONUS TYRE PRESSURE GUAGE

LIMITED QUANTITY AVAILABLE

METAL SIREN HORN
15W horn speaker with siren driver 12VDC operation. Ideal for car or house alarms. Sound level 115dB/12V. Current drain 500mA. Waterproof. Limited quantity.
Cat. LA-5700 Cat. Price $29.95
Now $19.95 Save $10

WHAT A FLOP!!
BELOW COST

TATTLE TALE VIBRATION ALARM
Keep the cat off of the lounge! Tattle tale can detect vibration in an object or surface without any apparent motion. Made in USA. See 97 Cat. page 176.
Cat. LA-5270
Cat. Price $39.95 Save $29.95
Now $10

MULTIMEDIA STEREO AMPLIFIER CARD KIT AND SPEAKERS
Refer SC Oct. 96. See 97 Cat. page 10 for details.
Cat. KC-5213 Save $69
Cat. Price $159
Now $99

BUTANE MINI TOOL AND SOLDERING TIP
Save $6.00
This mini gas flame torch is only 135mm long, and this deal includes the soldering tip.
Cat. TS-1410 Butane Tool $12.95
Cat. TS-1412 Soldering Tip $10.95
$23.90
Buy both for $17.90

LAMINATOR
Ideal for business cards and photos. Limited qty.
Was $79.95 **Now$65** Save $14.95
Laminating Sleeves
For business cards
Pkt. 100 XL-2504 $6.95
For Photos (6x4)
Pkt. 24 XL-2505 $4.95

CAR IMMOBOLIZER WITH CODE LEARNING KEYS.
Features.
•Code learning keys •3 separate disable circuits •Passive arming •Tamper memory •Arming memory •Car horn can be connected. See 97 Cat. page 74 for full details.
1/2 PRICE
Cat. LA-8920 Cat. Price $99.50
Now $49.50

ALARM STICKERS
CAR Sticks to inside of window. Size 72x32mm.
WARNING
Cat. LA-5100 **$1ea**

HOME Sticks to outside of window, or most surfaces. Size 120 x 80mm.
Cat. LA-5102 **$2.00ea**

12V 26W TWIN TUBE FLURO LIGHT
Contains 2 x13W tubes. On/off switch. 600mm long.
Cat. ST-3021
Cat. Price $29.95 **Oct.$22.95** Save $7

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

SUPER MOUSE 2

3 button mouse to suit IBM compatible PC's.
Cat. XM-5110
Cat. Price $19.95
Oct. $12.95
Save $7.00

MICRON PULSE COUNT PIR

Cat. LA-5030
Normally $29.95
Oct. $25ea
Buy 5 $22ea

OPTIONAL LENSES AVAILABLE

LONG RANGE	Cat. LA-5031	$4.95
CURTAIN	Cat. LA-5032	$4.95

STETHESCOPE

Cat. QM-7255
Cat. Price $9.95
Save $3
Oct $6.95

CLOCK MOVEMENT

Make your own clock, or fix your old broken clock.
Cat. XC-0100 **$9.95**

CCD MINI CAMERA

This mini camera comes in a black metal case that measures only 35(W) x 35(H) x 15(D)mm!! Unbelievably small. Supplied with mounting bracket and lead with DC socket and BNC socket. Requires 12VDC, and connects to any standard video input - like your VCR, or via an RF modulator to a TV aerial.
Cat. QC-3470 **Only $149.50**

"LOOKS LIKE A PIR" CAMERA

Includes infra red LEDs for night illumination.
Cat. QC-3450
$159.50

SUBWOOFER DEALS

Add a subwoofer/amplifier to your car sound system

Deal #1

AMPLIFIER New 4 x 50 WRMS
Bridge 2 channels together to give about 100W RMS to drive the sub. and that leaves 50 WRMS x 2 to drive your rear speakers.
Cat. AA-0438 **$319**

SUBWOOFER
10" Polycone Re/Sponse
Cat. CS-2236 **$99**

SUBWOOFER CABINET
Supplied in knockdown form.
Cat. CS-2532 **$99.50**

Total $517.50
Save $78.50 - Buy together for $439

Deal #2

AMPLIFIER
New 2 x 100 WRMS
Bridge 2 channels together to give about 200W RMS to drive the sub.
Cat. AA-0432 **$229**

SUBWOOFER
10" Polycone Re/Sponse
Cat. CS-2236 **$99**

SUBWOOFER CABINET
Supplied in knockdown form.
Cat. CS-2532 **$99.50**

Total $427.50
Save $68.50 - Buy together for $359

Add $50 for Carbon Fibre Woofer Cat. CS-2244

INFRA RED LEDS FOR CCD CAMERAS

$1.25ea or 10 for $10
Use our ZD-1945.
Specs are in the 97 Cat. P154. Cat. ZD-1945

2 WAY SPEAKER SWITCH

See 97 Cat. page 51 for more details.
Cat. AC-1640
Was $29.95
Oct. $20
Save $ 9.95

LASER POINTERS

Cat. ST-3100 **$39**

KEYRING SAVE
Cat. ST-3102 **$49**

POCKET SHIFTER MULTITOOL

Great pocket tool. Its a shifter (max jaw opening 18mm) and pocket knife type extras - phillips & slotted screwdriver, file, can opener, bottle opener, knife. Supplied in a holder with belt clip. Made in Taiwan. Cat. TH-1905

HALF PRICE

Was $19.95 Save $9.95
Oct. $10

4 WAY PARALLEL AUTO PRINTER SWITCH

See 97 Cat. page 161 for full details.
Cat. XC-5080
Was $47.85
Oct. $35 **Save $ 12.85**

SUPER BRIGHT 5MM RGB LED

Emits red, orange, yellow, green, blue and white. Specs: red 45mcD, green 15mcD, blue 3mcD.
Cat. ZD-1798
Cat. Price $9.95
Oct $6.95 Save $3

GOLD SPEAKER STANDS

See 97 Cat. page 49 for full details.
Cat. HS-8000
Was $29.95
Oct. $20
Save $ 9.95

INSTRUMENT SPEAKERS

See 97 Cat. P41.

10" 65WRMS
Cat. CG-2376
Was $57.50
Oct. $39.50 Save $18

12" 100WRMS
Cat. CG-2380
Was $99.50
Oct. $75 Save $24.50

BUY 10 LESS 10%

THE ROCK SPEAKER!

Looks like a rock.

Speaker is a quality 8" woofer and separate 2" tweeter Power handling 40WRMS. See 97 Cat. page 40 for full details.
Cat. CE-2300
Was $99
Now $69
Save $30

MICROTAC HANDS FREE KIT

Plugs into bottom of phone and cigarette lighter. Includes plug-in earpiece for private conversation if required.
Cat. YT-6105
Cat. Price $69.95
Oct. $49.95 Save $20

Save Big $$$$

MICROTAC NEW LI-ION BATTERY

Power Plus! When used with a 8400/8700 Motorola you get 120 hours standby and 540 mins talktime, and with a Microtac you get 40 hours standby & 150 mins talktime - and no memory effect Cat. SB-2572
Was $139.50 Now $99.50 Save $40

"FULL HOUSE" POWER DRIVER BIT SET

All the weirdo driver bits in one go!!
-The set consists of 32, of the driver bits that you don't normally see. You don't get any slotted, Phillips or Posidrive bits. You do get: •4 x Tri - wing, size 1, 2, 3, and 4 •9 x Torx (tamperproof), size T8, T10, T15, T20, T25, T27, T30 and T35 •4 x Pin drive (snake), size 4, 6, 8 and10 •6 x In - Hex (allen), *metric, size 2, 2.5, 3, 4, 5 and 6 •6 x In - Hex (allen), *imperial size 5/64", 3/32", 7/64", 1/8", 9/64" and 5/32" •3 x Torque Set, size 8, 9 and 10. With this you get a hex driver with magnetic retainer, all in a nifty plastic - rubber holder that is smaller than a deck of cards! (67 x 45 x 30mm). you will never get stopped by a wacko screw ever again!!

Save $8 Was $29.95
Cat. TD-2035
Only $21.95

SAVE $$$ ON SPEAKERS

8Ω POLYPROPYLENE WOOFERS

Size	Power	Cat.	Page	Was	Now	Save
6"	30WRMS	CW-2108	34	32.00	22.00	10.00
8"	60WRMS	CW-2114	35	52.50	39.50	13.00
10"	70WRMS	CW-2115	36	67.95	49.95	18.00
12"	80WRMS	CW-2130	38	86.95	64.95	22.00

8Ω **Polycone Midrange** CM-2085 See Cat. P33
Was $29.95 **Oct. $19.95** Save $10

RESPONSE **Dome Midrange** Cat. CM-2090
Was $39.95 **Now $24.95** Save $15

VIFA 5" P13WG Cat. CM-2104 See 97 Cat. page 33
Was $89.50 **Now $49.50** Save $40

Plastic back to seal driver Cat. CF-2740
Was $9.95 **Now $4.95**

CELLULAR BATTERIES SAVE BIG $$$

Type	Cat	Was	Now $
Nokia 232 Nicad 1000mAH	SB-2556	39.50	15.00
Nokia 100 Ni-Mh 1200mAH	SB-2551	49.95	39.95
Nokia 101 Ni-Mh 1200mAH	SB-2555	49.95	39.95
Nokia 232 Ni-Mh 1100mAH	SB-2558	49.50	25.00
Nokia 2110 Nicad 1100mAH	SB-2560	39.50	25.00
Nokia 2010 Ni-Mh 1200mAH	SB-2564	45.00	30.00
Microtac Slim Ni-Mh 900mAH	SB-2569	79.95	60.00
Microtac Ni-Mh 1200mAH	SB-2570	59.50	45.00
Microtac Ni-Mh 2100mAH	SB-2571	79.50	59.95
Ericsson 337 Ni-Mh 1200mAH	SB-2578	49.50	35.00
NEC P3 Nicad 700mAH	SB-2580	49.50	20.00
NEC P3 Ni-Mh 1200mAH	SB-2581	49.50	35.00
NEC Sportz Ni-Mh 1200mAH	SB-2583	49.50	39.50
Philips Fizz Ni-Mh 1800mAH	SB-2590	69.95	49.95

REMOTE CONTROLS

PREPROGRAMMED
Cat. AR-1700
$29.95
LCD DISPLAY WITH BACKLIGHT
Cat. AR-1725
$169.50

Also available
PROGRAMMABLE UNIT
Cat. AR-1710 **$43.95**
PREPROGRAMED AND PROGRAMMABLE UNITS
Cat. AR-1705 **$69.95**

NEW POWER SUPPLIES

Save $20 on each model.

12VDC 2AMP REGULATED

Cat. MP-3017 **NEW**
Was $69.95 Now $49.95

13.8VDC 2AMP UNREGULATED

Cat. MP-3018 **NEW**
Was $59.95 Now $39.95

EXTREMELY LARGE LCD DIGITAL CLOCK WITH CALENDAR AND TEMPERATURE NEW

This must be the largest LCD clock we have ever seen! Ideal for warehouses, factories, offices and home etc. Includes: •Temperature readout in C or F •Calendar with day, date and month display •12 or 24 hour time •Huge 152 x 94 LCD display with actual time digits 55mm high •Total size 210(w) x 230(h) x 25(d)mm. Charcoal in colour. Operates from 2 x AA batteries.

Cat. XC-0230 **Only $79.95**

PAPST TURNTABLE MOTOR

See July or August Adverts for full details on these quality German made PAPST motors.
Cat. YM-2700 ***Was $49.95 Oct $39.95ea***

CELLULAR PHONE CASES SELLOUT

$10 EACH SAVE $$

NOKIA 100/101/121
Cat. HC-6900
ERICSSON 337
Cat. HC-6908
NEC SPORTZ
Cat. HC-6909
MICROTAC
Cat. HC-6912
NOKIA 2110
Cat. HC-6914

$5 EACH

NOKIA 232
Cat. HC-6902
MOTOROLA 9000
Cat. HC-6906
NEC P3
Cat. HC-6910
MOTOROLA FLARE
Cat. HC-6913

TRAVEL WORLD CLOCK CALENDAR

Features •16 City times •200 year calendar •Clock •Alarm •Calculator •Folds up •Limited quantity available.Cat. QM-7282
Was $19.95
Oct $12 ***Save $7.95***

ALARM CHRONOGRAPH CALCULATOR WATCH

1/2 PRICE

Features •Time •Date •12/24 hour mode •Chronograph in 1/100 second •Alarm •8 digit calculator. Cat. XC-0265
Was $12.95 ***Now $6.50***

WORLD TIME CALCULATOR WATCH

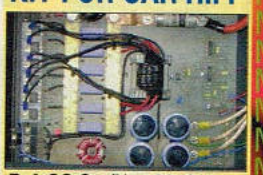
1/2 PRICE

Features •12 Cities plus 1 free zone •Time •Alarm •Calculator. Cat. XC-0270
Was $12.95 Now $6.50

SHOTGUN VIDEO CAMERA MIC

Designed to pick up sound a long way away, as well as close up with the flick of a switch.
Cat. AM-4085
Cat. Price $59.95
Now $44.95
Save $15.00

600W DC/DC CONVERTER KIT FOR CAR HIFI



Ref. SC Oct/Nov 96. See Cat. page 6 for full details.
Cat. KC-5212
Cat. Price $299
Now $199
Save $100

JUMBO HYGROMETER

Reads the temperature and humidity with large display. QM-7202

Now Only $49.95

LOW VOLTAGE TV AMP/SPLITTER

For indoor use. Input, 2 outputs. Requires 12VDC 120mA. Sellout price. Limited quantity. See Cat. page 166 for full details.

Cat. LT-3286
Was $29.95
Oct $19.95
Save $10

WELLER PORTASOL

Cat. TS-1720
$49.95

DIGI PROBE MULTIMETER

This fantastic 3.5 digit meter is actually easier to use than a conventional hand-held unit. The readout is in the body of the 'probe' itself so you don"t have to avert your eyes to get a circuit reading. •Logic Test •Diode Test •Continuity Buzzer •Manual Range •Auto range •Data Hold. Supplied with a quality ground lead (for the DMM) & logic return lead.

Normally $49.95 Save $10
At Jaycar $39.95

BARGAIN ANTISTATIC MAT NEW

Our supplier sent us the wrong size, their loss - your gain! these are 650mm x 500mm, which is double the size of our TH-1782 which sells at $19.95.
Cat. TH-1783
Only $20

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

JAYCAR ELECTRONICS

SCOOP PURCHASE OF THE DECADE

AURA INTERACTOR

Plug it into computer games, stereos etc, then put the back pack on and feel all the low frequency sounds. See previous ads for full details. Cat. XC-1000

SAVE $210!

WAS $249
THEN $49.95
OCTOBER
$39.95

ARLEC SECURITY BEAM NEW

This security beam is ideal for use in shops, reception areas, factories, warehouses or any unattended doorway or entrance area. It uses an infrared beam, and a buzzer sounds when the beam is broken. Ideal range is 2 - 8 metres. Complete with mains adaptor.

Cat. LA-5190 $195

GME Kingray HI QUALITY MASTHEAD DIPLEXER

Allows you to connect both a UHF antenna and VHF antenna into the diplexer, then run 1 cable to the house. Mounts onto TV mast. Australian made.Cat. LT-3015

$22.95 NEW

GME Kingray 4 WAY MASTHEAD AMPLIFIER

These are Australian made, and are very good quality. If you have up to 4 TV's in your home, why not use a Masthead amp, then run a separate lead to each TV from the mast. This way you do not lose any signal through the splitters. Max. gain VHF 10dB/ UHF 12dB. Supplied with mains power supply.

NEW

Cat. LT-3292 $110

REMOVEABLE HARD DISC CARRIER + FRAME

NEW

Ever wanted to transport large amounts of information without using a Zip Drive or a CD ROM writer. Now you can without breaking the bank. Use any type of 3.5" or 2.5" hard disk between two PC's e.g. home & work. Quality made unit •Lockable cradle •Power LED + HDD usage LED •Fits a standard drive bay

IDE KIT Cat. XC-4670
SCSI KIT Cat. XC-4671 $39.95ea

LCD DISPLAY SURPLUS NEW

These are 4 digit 7 segment field effect LCD displays suitable for battery powered applications. Pins are 0.1" centres and plug directly into PCB or socket strips. 4 digit, character height 12.7mm. Display size is 50 x 30mm and pin spacing is 33mm. Limited quantity available. Normally around $14. Cat. ZD-1885

Only $4.95ea

ARLEC DIGITAL TIMER

•Automatically switches lights or appliances on and off with up to 12 commands. •Daily 24hr programming •Weekday, weekend and 7 day programming •Random on/off and daylight saving 1 hour advance. Arlec brand.

NEW

Cat. XW-0402

Only $47.95

11 DIGIT FLUORO BARGAIN

NEW

Vacuum fluorescent displays - still look the best. Once again Jaycar has purchased a substantial quantity of a quality Futaba brand vacuum fluorescent displays. Each digit measures 6.0mm(H) x 3.5mm(W), 11 digits in all. The display also features an apostrophe in the top right hand corner of the digits, and a semicolon (;) in the bottom in all 11 digits. Electrical and mechanical data is incl in the price.

Cat. ZD-1880 Only $3.95ea / 10 up $3.50

Not to forget! Allegro brand UDN6118A Driver IC

Cat. ZD-1882 Only $4.95 10 up $4.40

PIHER HORIZONTAL TRIMPOTS NEW

Features: •Dust proof enclosure •Polyester substrate •Wiper positioned at 50% •Accidental rotor movement protected. Specifications: •Max voltage 100V •Nom power 0.1W •Linear curve •Tolerance +/- 30% •End resistance 10Ω.

Value	Cat#	Value	Cat#
200Ω	RT-4350	20K	RT-4362
500Ω	RT-4352	50K	RT-4364
1K	RT-4354	100K	RT-4366
2K	RT-4356	250K	RT-4368
5K	RT-4358	500K	RT-4370
10K	RT-4360	1M	RT-4372

All One Price 70c ea

BEST QUALITY 6.5MM PLUGS

NEW

These use the same high quality aluminium case as our best quality RCA plugs. Plugs are gold, and available in both mono and stereo. Cable entry diameter is 6mm.

MONO	RED	Cat. PP-0151
MONO	BLACK	Cat. PP-0152
STEREO	RED	Cat. PP-0177
STEREO	BLACK	Cat. PP-0178

All Only $4.50ea

12V DIL LATCHING MINI RELAY

AVAILABLE ONCE AGAIN!!

DIP style - will plug into 16 pin IC socket. Low profile mini 12V 2 coil latching relay. Highly sensitive - 400mW nominal operating power.

NEW

Specifications Coil • 2 coil latching • 12 volts DC • Minimum set and reset power 180mW • Nominal set and reset power 360mW Specifications Contact • Max switching power 60W, 125VA • Max switching power 220V DC, 250V AC • Max switching current 2A AC/DC • Max carrying current 3A AC/DC • Size 20x10x 10(H)mm

Cat. SY-4060 $9.95

RESPONSE PRO MIC CABLE

The best quality microphone cable for all P.A. and stage use. Super flexible black matt finish PVC low noise cable with tinned copper shielding.

2 CORE SHIELDED

Cat WB-1530 NEW

Specs: 24/0.20 x 2 core + 112/0.12 Colour: red & white conductors. Outer dia: 6.5mm

$2.20 / mtr or $150 / 100 mtr roll

4 CORE SHIELDED

Cat WB-1540 NEW

Specs: 11/0.20 x 4 core + 112/0.12 Colour: red,white,yellow & black. Outer dia: 6.6mm

$2.75 / mtr or $192 / 100 mtr roll

SINGLE SHIELDED CABLE

Save Big $$$$

This is in our catalogue as Mic cable, but does not have a cotton filler. It can be used as audio cable, or wherever a single shielded cable is required. Specs: Lead with wire 7/0.12mm, shield 28/0.12mm, OD 4.6mm, colour - black.

Cat. WB-1520

Cat. Price $1.70m
$116/100m roll.
Oct. Price 80¢ m
$40/100m roll.

HIGH BRIGHTNESS BLUE LED NEW

Wow! This is the brightest blue LED we've ever seen! 650mcd at 3.6V. Size is 5mm.

Cat. ZD-1797 $9.95

20 MT. ROLL OF MONITOR OFC SPEAKER CABLE NEW

Save 75c per mt. over buying from a big reel. Supplied on a plastic reel.

Cat. WB-1736 Only $69.00

5 AMP NOISE SUPPRESSOR NEW

Easy to use noise suppressor for car stereos. Connects in power lead before stereo. Features gold plated terminals and housed in round plastic case. Three wire connection. Cat. AA-3050

Only $12.95

JAYCAR WHOLESALE

All Jaycar products are available at very competitive wholesale prices. If you are tired of your current unreliable supplier, why not give Jaycar a try. You'll be pleasantly surprised.

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

JAYCAR ELECTRONICS

JAYCAR ELECTRONICS

UHF/VHF FRINGE BARGAIN ANTENNA

The big brother to our best selling antenna. Its bigger and is ideal for using in fringe area locations. Receives UHF channels 28 to 36 (band 4) and VHF channels 0-11. This antenna is $50 less than the brand name equivalent. Boom length 2mts., 7 x VHF elements, 12 UHF elements and includes 75Ω balun to run coax. Please note that the big VHF elements are 1.3mts. long, so if you live in an area that very large birds frequent, beware! Cat. LT-3142

AMAZING PRICE! Only $79.95

HEATSHRINK TUBING

SHRINKS UP TO 50%. LENGTH 1.2 METRES

1.5mm - Shrinks to 0.75mm — **$1.40**
Red WH-5540/Black WH-5530/Clear WH-5550

2.5mm - Shrinks to 1.25mm — **$1.40**
Red WH-5541/Black WH-5531/Clear WH-5551

3.0mm - Shrinks to 1.55mm — **$1.50**
Red WH-5542/Black WH-5532/Clear WH-5552

5.0mm - Shrinks to 2.5mm — **$1.80**
Red WH-5543/Black WH-5533/Clear WH-5553

6.0mm - Shrinks to 3.0mm — **$2.10**
Red WH-5544/Black WH-5534/Clear WH-5554

10mm - Shrinks to 5.0mm — **$2.50**
Red WH-5545/Black WH-5535/Clear WH-5555

16mm - Shrinks to 8mm — **$3.95**
Red WH-5546/Black WH-5536/Clear WH-5556

20mm - Shrinks to 10mm — **$3.95**
Red WH-5547/Black WH-5537/Clear WH-5557

COMPONENT PACKS

60 CERAMICS
Cat. RC-5399
$4.95

60 GREENCAPS
Cat. RC-5199
$7.95

55 ELECTROLYTICS
Cat. RE-6250
$7.95

160 MIXED CAPACITORS
Cat. RE-6260
$10.00

100 TANTALUMS
Cat. RZ-6690
$10.00

100 MIXED SEMI-CONDUCTORS
Cat. ZP-8990
$10.00

100 BC TRANSISTORS
Cat. ZT-2170
$11.95

100 ASSORTED LEDS
Cat. ZD-1694
$19.50

1700 1/4W 5% RESISTORS
Cat. RR-2000
$24.95

300 1/2W 1% MINI SIZE RESISTORS
Cat. RR-0680
$9.95

300 1/4W 5% RESISTORS
Cat. RR-1680
$5.95

SHORT CIRCUITS

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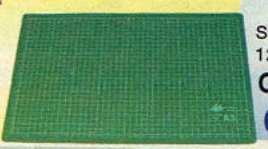

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REFER SILICON CHIP OCTOBER, 1997

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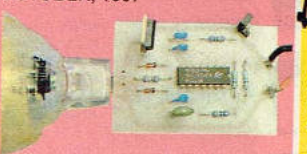

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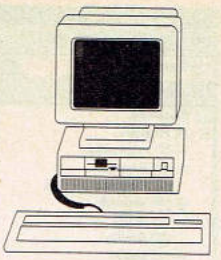
COMPUTER BITS

BY JASON COLE



Customising the Windows 95 Start Menus

You don't have to put up with your Start Menu the way it is. It's easy to rearrange it just the way you want, so that it's more convenient to use. We show you how.

In Windows 95, the Start Menu is the focus point for launching programs. As you probably know, Windows 95 utilises shortcuts extensively. These shortcuts aren't the actual program but a street sign for the computer so that it knows where to go to run the program. We usually put our own shortcuts on the Desktop along with often-used files but you can't overdo it otherwise the Desktop can get a bit crowded.

A better and less confusing approach is to launch lesser-used programs from the Start button. This is located on the lefthand side of the Taskbar which itself is usually located at the bottom of the screen. You don't have to have it at the bottom of the screen, by the way. If you want it at the top of the screen instead (or along one side), just drag it to its new location using the mouse.

But back the Start button and its associated menus.

One of the problems here is that as each new program is installed, it adds one or more new shortcuts to the Programs section of the Start Menu. Sometimes, even shortcuts to "readme" files are added which means that, over a period of time, your Start Menu can become quite cluttered. I've even seen cases where a Start Menu occupied virtually the entire screen when the wanted program was buried several layers deep.

And that's another problem. Often, it would be more convenient to have a particular program near the front of the Start Menu so that you don't have to drill down to get at it. Equally, it would be better if other less-used programs were further up the back, so that they were out of the way,

Well, the good news is that you don't have to put up with your Start Menu the way it is. You can easily rearrange it and even delete unwanted shortcuts from it, so that it is less cluttered and easier to use. Those "readme" file shortcuts are prime candidates for the Recycle Bin, for example.

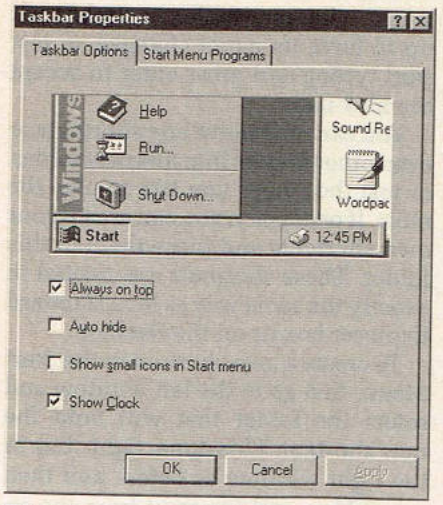


Fig.1: you get to this dialog box by clicking Start, Settings, Taskbar. Alternatively, you can right click the Taskbar and select Properties.

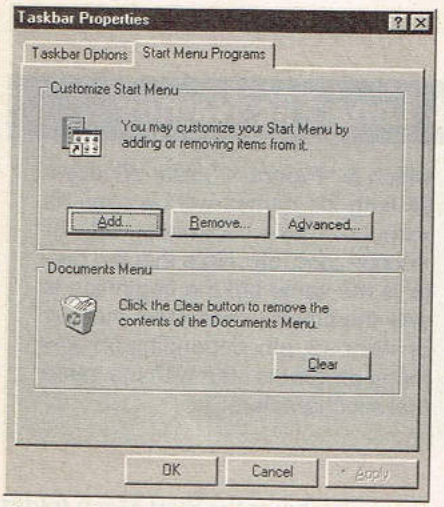


Fig.2: select the Start Menu Programs tab and then click the Advanced button to open an Explorer like window of the Start Menu folder.

Let's rearrange things

Before starting, the first thing to realise is that the entries in the Start Menus simply mirror the shortcuts in the Start Menu folder and its subfolders. The Start Menu folder, by the way, is automatically created when Windows 95 is installed.

You can rearrange the Start Menu by using Explorer but the correct method is to use the Start Menu Wizard. To get to the Wizard, click the Start button, then go to Settings and select Taskbar. This will bring up the Taskbar Properties dialog box – see Fig.1.

Select the Start Menu Programs tab,

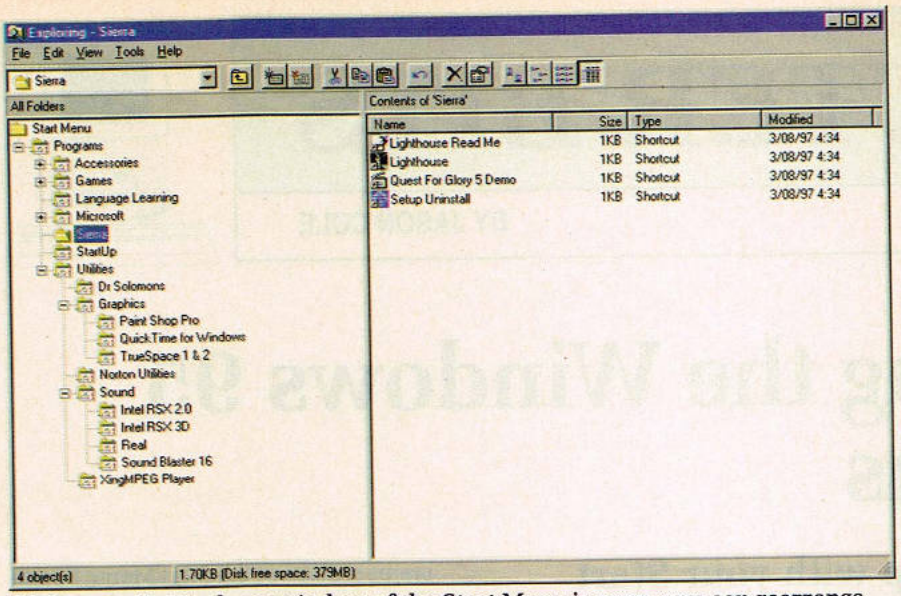


Fig.3: once the Explorer window of the Start Menu is open, you can rearrange the various menus simply by dragging the shortcuts around.

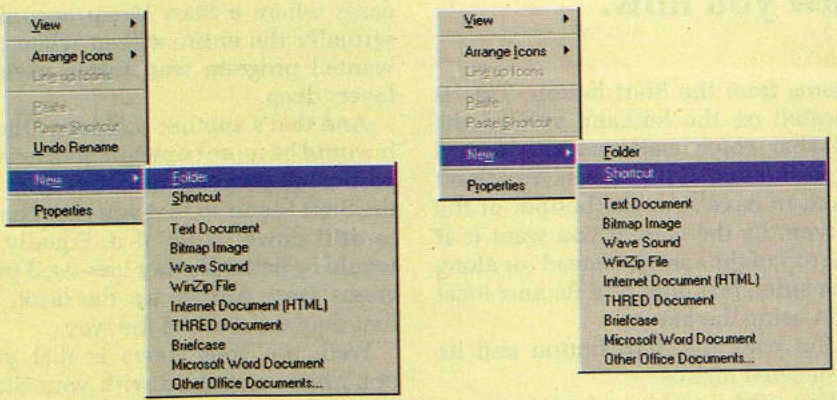


Fig.4: you can create a new folder or shortcut by first selecting the folder that will hold it in the lefthand pane of the Explorer, then right clicking the righthand pane. It is then a matter of selecting either Folder or Shortcut from the drop-down menus.

Tip: Old Programs & Long File Names

When installing an old Windows 3.1x program in Windows 95, you may find that it cannot find or accept "Program Files" as a folder name. That is because the old programs do not understand anything other than the 8.3 character format.

To overcome this, you have to use the 8.3 name for Program Files which is "Progra~1". Any Windows 95 long file names will be seen as xxxxxx~1.exe, xxxxxx~.txt or xxxxxx~.doc, etc. Note that the prefix is the same but the beginning is only the first six characters then ~1 or ~2 or ~3, etc, depending on how many programs start with the same first six characters.

then click the Advanced button (Fig.2). You will now see an Explorer-style window as shown in Fig.3. However, unlike a standard Explorer window, this only shows the Start Menu folder which is exactly what we want.

You can now rearrange your Start Menus by simply moving the shortcuts around. Don't do this in a haphazard manner though – instead, the Start Menu folder should be organised so that it makes sense to you and so that it is more convenient to use.

If you use a particular program quite often, then don't put it six folders down. Feel free to experiment because you are not going to lose any programs or the Start button. At worse, you can only lose the shortcut to a program and new shortcuts are easy to create.

To move a shortcut or folder, just left click on what you want to move, drag it to where you want it to go, and let go of the mouse button. And that's it – the next time you click the Start button and go through the various menus, the item will appear in its new location.

Adding new folders

Creating new folders is a little different. If you want to create a folder called "Games" in the "Programs" folder, for example, you first click on the "Programs" folder in the lefthand panel. This selects the folder that you want to create the new folder in.

You now go to the righthand pane (which lists the contents of the Programs folder) and click the right mouse button on a vacant space. This brings up a small options panel. Go to the New option and then select the Folder option from the drop-down list – see Fig.4.

A new folder will now appear at the bottom of the list of files. The first thing you do to this folder is change its name from "New Folder" to "Games" (or whatever name you want). The new folder is already set up to have its name changed so just start typing and press enter to accept the new name.

You can now move any shortcuts or even other folders into this new folder, or just the games you like to play the most. If necessary, you can create your own shortcuts and place them in this folder. These shortcuts are created in exactly the same way as for a standard Explorer box or on the Desktop.

To create a new shortcut in the Start Menu, first go to the left window and select the folder that will hold the new shortcut. This done, right click in the right window as before and then select New and Shortcut from the resulting drop-down menus. A new window will then appear asking for a command – see Fig.5.

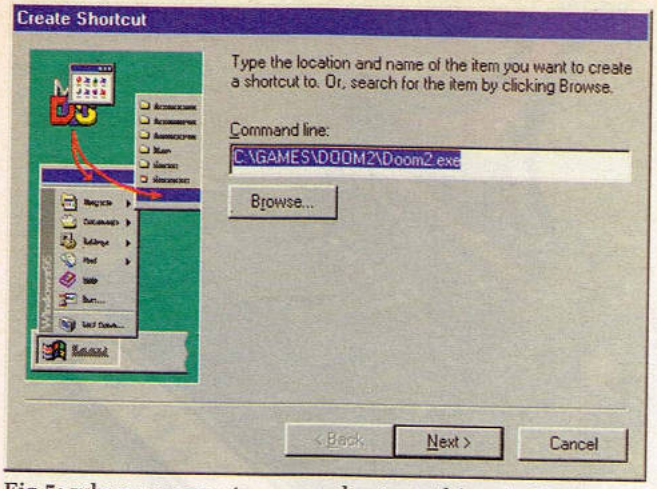

Create Shortcut
Type the location and name of the item you want to create a shortcut to. Or, search for the item by clicking Browse.
Command line:
C:\GAMES\DOOM2\Doom2.exe
Browse...
< Back
Next >
Cancel

Fig.5: when you create a new shortcut, this window appears and you have to type in the command line for the program. Note that you must include the path.

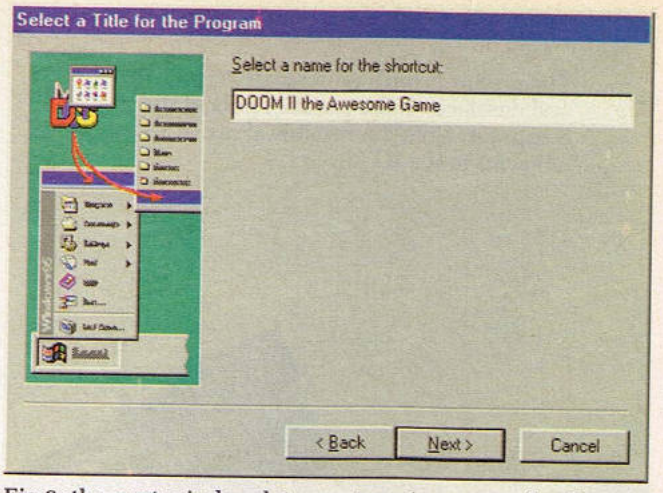


Fig.6: the next window lets you type in a name for the shortcut. You can type in any name you like to replace the default which will be the name of the program.

The command line that you enter here is simply the program that you want the shortcut to point to. Note that you must include the path; eg, c:\games\doom2\doom2.exe (for the games program Doom 2). You then press the Next button to bring up the window shown in Fig.6, into which you can type the name of the shortcut.

Note that this window will come up with a default which shows the name of the program, in this case doom2.exe. You can change this to whatever you want (eg, DOOM II the Awesome Game), as this is only the name of the shortcut and in no way affects the program itself.

Now press the Next button and your next task will be to choose an icon. Finally, press Finish to make the new shortcut appear in the folder. If it appears in the wrong place, don't worry – all you have to do select it and drag it into the correct folder.

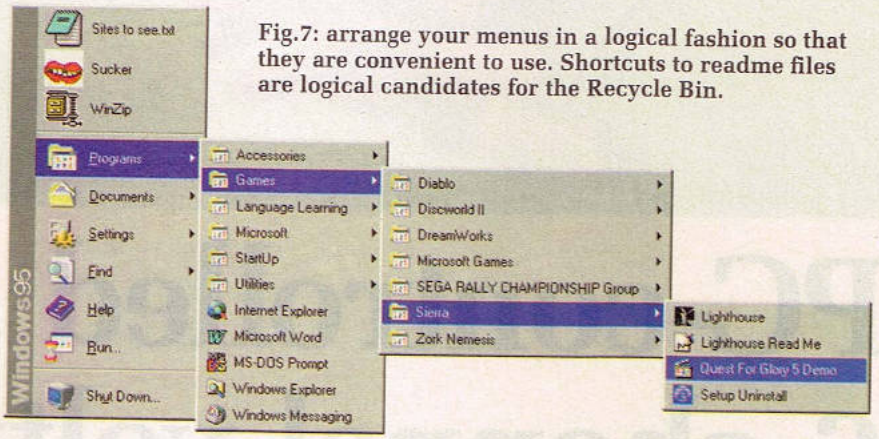
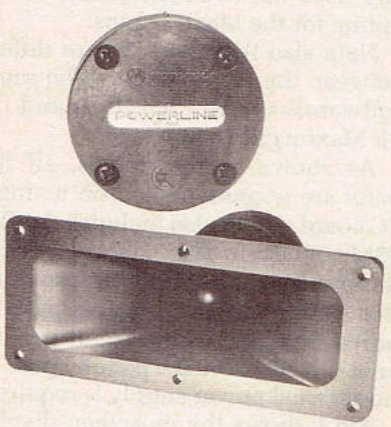


Fig.7: arrange your menus in a logical fashion so that they are convenient to use. Shortcuts to readme files are logical candidates for the Recycle Bin.

And that's all you need to know to rearrange your Start Menu. The best way to learn is to have a go, so why not get started? **SC**

THE "HIGH" THAT LASTS IS MADE IN THE U.S.A.

Model KSN 1141



The new Powerline series of Motorola's 2kHz Horn speakers incorporate protection circuitry which allows them to be used safely with amplifiers rated as high as 400 watts. This results in a product that is practically blowout proof. Based upon extensive testing, Motorola is offering a 36 month money back guarantee on this product should it burn out.

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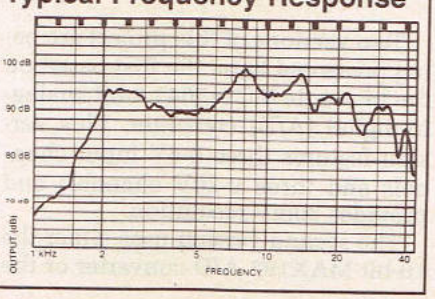
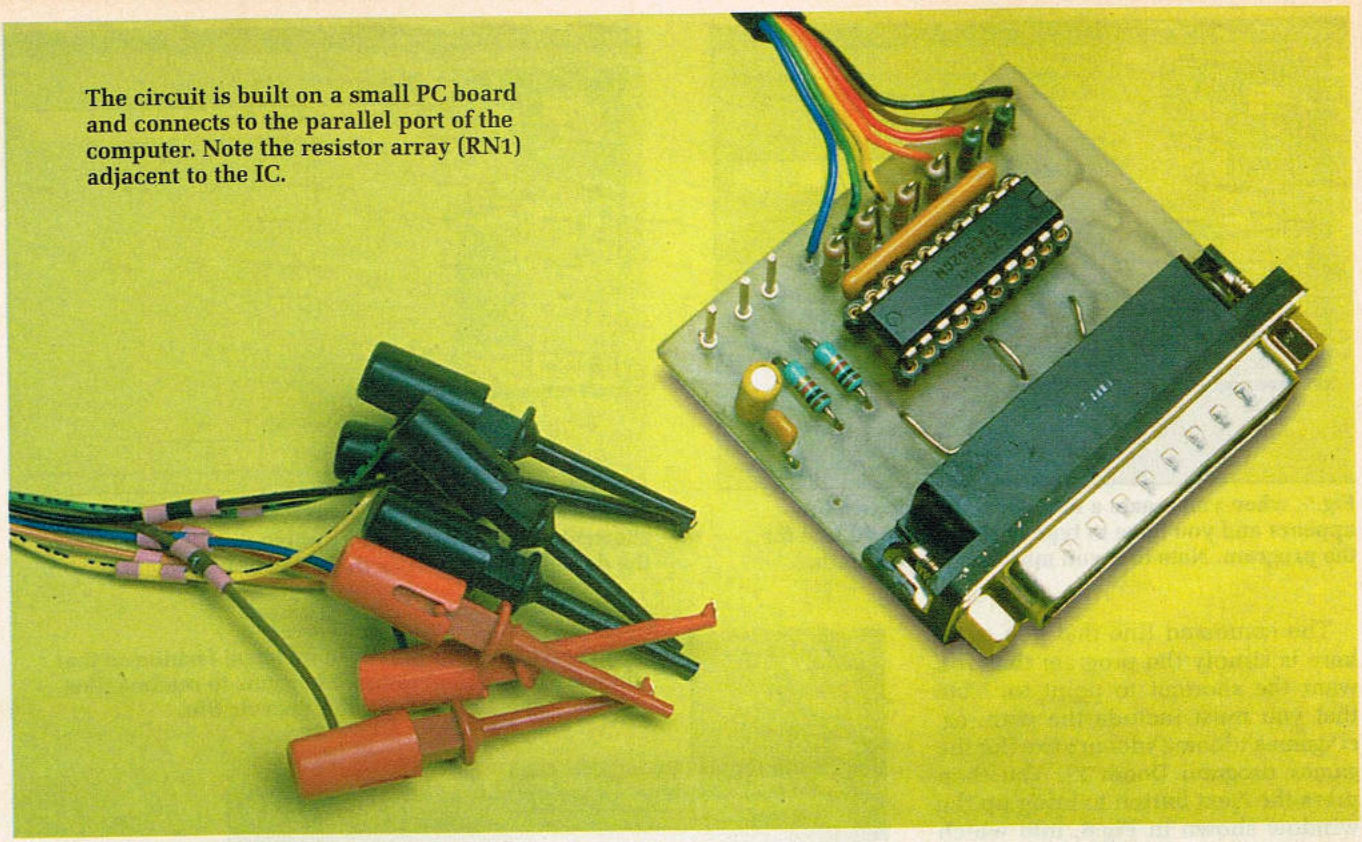
Max. Power Handling Capacity: 400W
Max. Temperature: 80°C
Typ. Imp: appears as a 0.3µF capacitor

Typical Frequency Response





The circuit is built on a small PC board and connects to the parallel port of the computer. Note the resistor array (RN1) adjacent to the IC.

PC-controlled 6-channel voltmeter

Consisting of just a handful of parts, this simple project plugs into your PC's parallel port to provide a 6-channel voltmeter. The companion software generates an on-screen display which shows the readings in both analog and digital format.

By MARK ROBERTS

Two versions of this project are being presented here, the first based on the Motorola MC145041 8-bit analog-to-digital (A/D) converter. This version features three 0-6V input channels and three 0-20V channels and provides 20mV resolution.

The second version uses either the 10-bit MAX192 A/D converter or the 12-bit MAX186 chip. It has the same voltage ranges as before but the resolution is improved to 4mV for the 10-bit chip and 1mV for the 12-bit chip. The downside of this version is that the Maxim devices are considerably more expensive than the 8-bit Motorola device.

As a guide, the Motorola MC145041 device and the equivalent TLC542CN device from Texas Instruments can be obtained for around $5. By contrast, the MAX192 and MAX186 devices cost around $20 and $55 respectively, so consider carefully whether you really need the extra resolution before opting for the Maxim chips.

Note also that the software differs between the two versions. The same software is used for the 10-bit and 12-bit Maxim chips, however.

As shown in the photos, all the parts are accommodated on a single PC board which also includes the DB-25M connector. This connector plugs directly into either LPT1 or (provided that your computer has two parallel ports) into LPT2. The circuit is powered directly from the parallel port, so no external power supply is required.

Fig.1 shows the on-screen display

generated by the software. As can be seen, there are separate "metered" (analog) and digital displays for each input channel. In addition, there is a "button" to toggle the power on or off (just click with the mouse), plus two smaller buttons that let you select the computer port (either LPT1 or LPT2).

Finally, there are two digital output buttons and these may be manually toggled on or off using the mouse. When an output is toggled on, it sends its corresponding output on the circuit board high and this can be used to remotely control an external device, either via an optocoupler or some other suitable interface circuit.

Note that this interface circuit should be suitably buffered or isolated to avoid damage to the parallel port.

Fig.1: this is the on-screen display generated by the software. Note that the Channel 0 bezel has changed to red here, indicating an overrange condition.

Applications

So what are the applications for such a device? A few that spring to mind include: (1) multi-channel analog acquisition; (2) testing or monitoring digital and analog circuits; (3) monitoring security systems; (4) industrial process control; and (5) battery management.

In short, you can use this device wherever it is necessary to monitor multiple DC voltages and have them all displayed on a computer monitor. Depending on the readings, you can also elect to remotely control one or two external devices at the click of a mouse button.

The 0-6V and 0-20V voltage ranges can be easily altered if necessary, to accommodate higher voltages. This is done by changing the voltage divider resistors at the inputs. This does not alter the voltage ranges shown on the "meters" however, so you will have to scale the readings yourself.

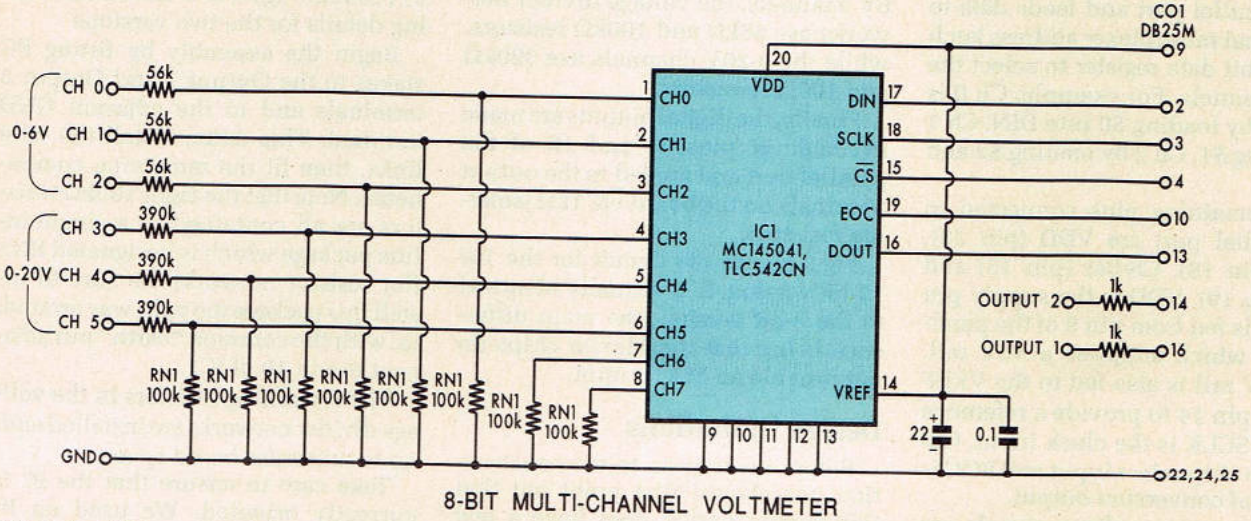
Circuit details

Refer now to Fig.2 – this shows the circuit details of the 8-bit version based on the Motorola MC145041 (or the TLC542) ADC (IC1).

IC1 is basically an 8-bit A/D converter with 11 analog input channels, although only six channels (0-5) are used here. The incoming data on each channel is fed to an internal multiplexer which selects each channel in turn, depending on the data fed to an internal address latch. The multiplexer output in turn drives the A/D converter section of the chip.

The resulting digital data for each channel is then shuffled out in serial fashion on the Dout line (pin 15) and fed to pin 13 of the parallel port. It is then displayed on the screen under software control – see Fig.1.

Pin 17 of IC1 is the serial data input



8-BIT MULTI-CHANNEL VOLTMETER

Fig.2: the 8-bit version is based on the Motorola MC145041 A/D converter (IC1).

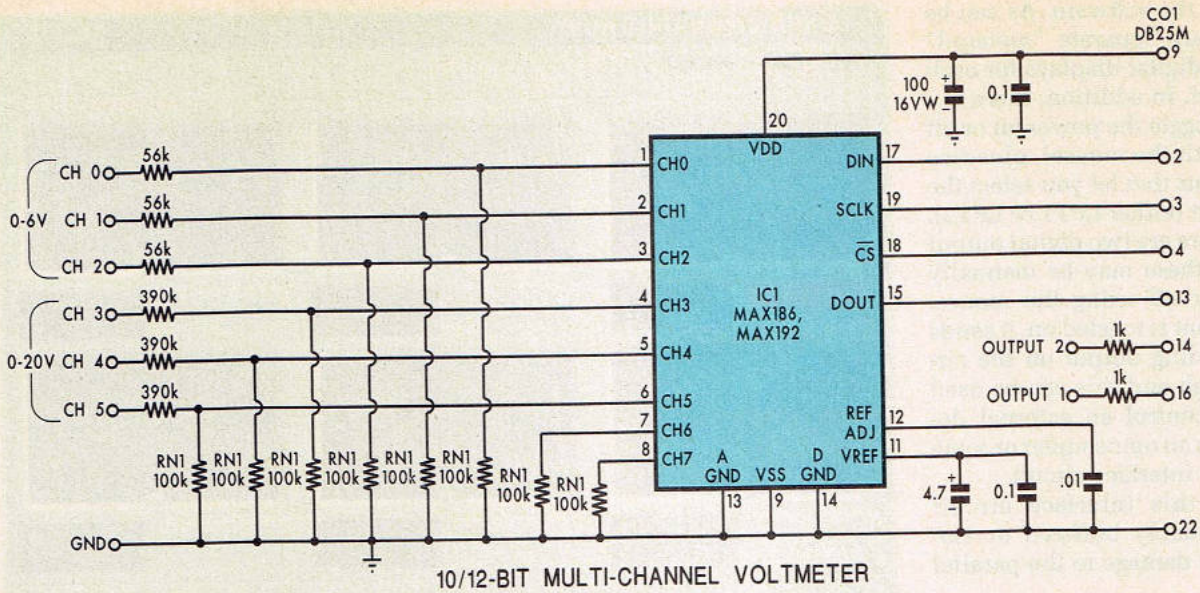


Fig.3: the 10/12-bit version is based on the MAX186 and MAX192 chips. The circuit is similar to the 8-bit version.

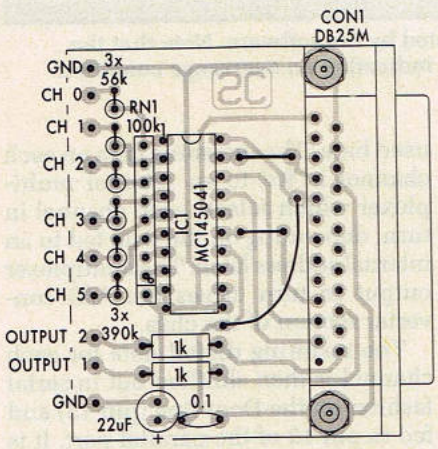


Fig.4: the parts layout for the 8-bit version.

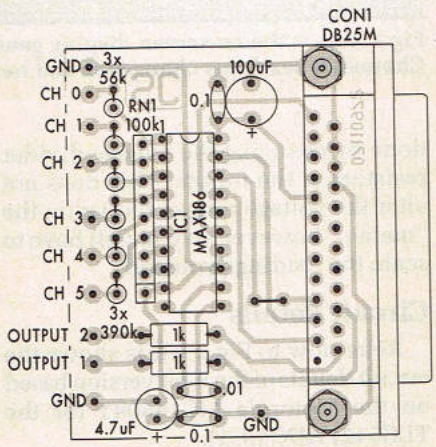


Fig.5: the parts layout for the 10/12-bit version.

(DIN). This input is driven from pin 2 of the parallel port and feeds data to the internal multiplexer address latch via an 8-bit data register to select the input channels. For example, Ch 0 is selected by loading $0 into DIN, Ch 1 by loading $1, Ch 2 by loading $2 and so on.

The remaining pins connected to the parallel port are VDD (pin 20), SCLK (pin 18), CS-bar (pin 15) and EOC (pin 19). VDD is the supply pin and this is fed from pin 9 of the parallel port which supplies a +5V rail. This +5V rail is also fed to the VREF input at pin 14 to provide a reference voltage. SCLK is the clock input, CS-bar is the chip select input and EOC is the end of conversion output.

The incoming voltage signals are fed to the CH0-CH5 inputs via voltage divider networks. In the case of the 0-6V channels, the voltage divider networks use 56kΩ and 100kΩ resistors, while the 0-20V channels use 390kΩ and 100kΩ resistors.

Finally, the digital outputs are made available at pins 14 and 16 of the parallel port and are fed to the output terminals on the board via 1kΩ isolating resistors.

Fig.3 shows the circuit for the 10/12-bit version. It is virtually identical to the 8-bit version, the main difference being that the Maxim chips do not provide an EOC output.

Design limitations

Before moving on to the construction, we should first point out that this simple design does have a few limitations. First of all, the accuracy of the readings for the 8-bit version will depend on the accuracy and stability of the 5V rail from the computer. By contrast, the Maxim devices feature an internal +4.096V reference so if accuracy and resolution are important, these are the devices to go for.

Second, the input impedance is only 156kΩ for the 0-6V channels and 490kΩ for the 0-20V channels. Depending on the circuit being measured, these relatively low input impedances may cause reading inaccuracies due to loading effects.

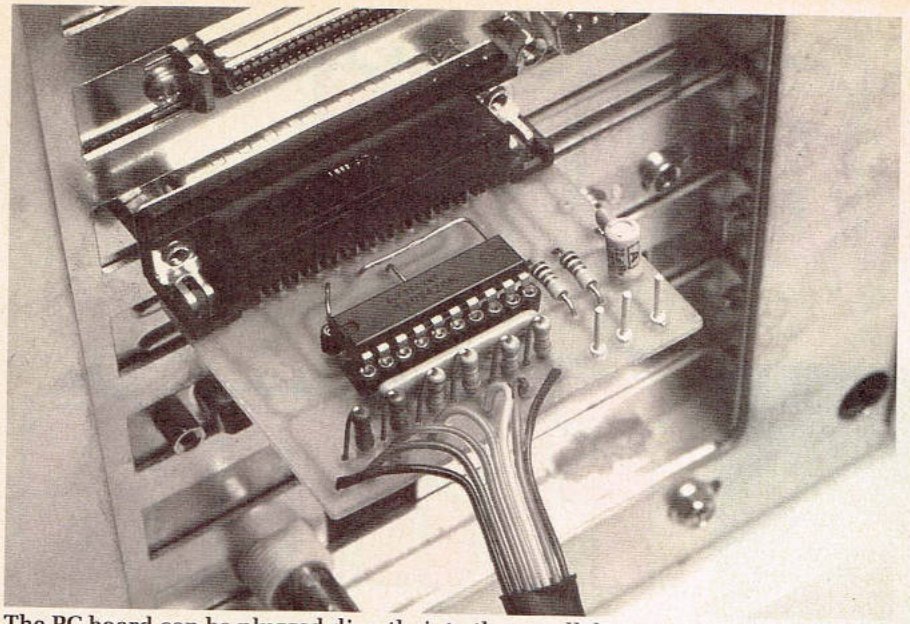
Construction

The 8-bit version of the Multi-Channel Voltmeter is built on a PC board coded 07110971, while the 10/12-bit version is built on a board coded 07110972. Figs.4 & 5 shows the wiring details for the two versions.

Begin the assembly by fitting PC stakes to the Output 1 and Output 2 terminals and to the adjacent GND terminal. This done, install the wire links, then fit the remaining components. Note that the eight 100kΩ resistors are all contained in a single in-line package which is designated RN1 (for resistor network). Be sure to install this package the right way around; ie, with the common "earth" pin adjacent to pin 10 of IC1.

The remaining resistors in the voltage divider networks are installed end-on to minimise board space.

Take care to ensure that the IC is correctly oriented. We used an IC socket on the 8-bit version but this



The PC board can be plugged directly into the parallel port or connected to the port via an extender cable fitted with DB25 connectors.

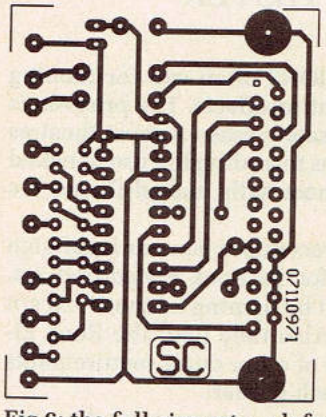


Fig.6: the full-size artwork for the 8-bit version.

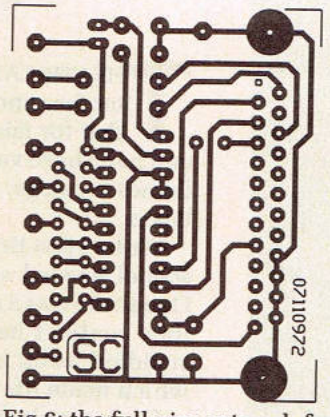


Fig.6: the full-zize artwork for the 10/12-bit version.

Parts List

8-Bit Version

1 PC board, code 07110971, 53 x 42mm
1 DB25M PC-mount connector
3 PC stakes
1 400mm-length 7-way rainbow cable
8 miniature hook connectors
1 MC145041 or TLC542CN 8-bit A/D converter IC
1 22µF 16VW electrolytic capacitor
1 0.1µF MKT capacitor
3 390kΩ resistors
1 8 x 100kΩ resistor network (RN1)
3 56kΩ resistors
2 1kΩ resistors

10/12-Bit Version

1 PC board, code 07110972, 53 x 42mm
1 DB25M PC-mount connector
3 PC stakes
1 400mm-length 7-way rainbow cable
8 miniature hook connectors
1 MAX186 (12-bit) or MAX192 (10-bit) A/D converter IC
1 4.7µF 16VW electrolytic capacitor
1 0.1µF MKT capacitor
1 .01µF MKT capacitor
3 390kΩ resistors
1 8 x 100kΩ resistor network (RN1)
3 56kΩ resistors
2 1kΩ resistors

can be considered optional. Complete the board assembly by soldering the DB25M connector into place.

The seven input leads (one for each input channel plus ground) can be run using rainbow cable. On the prototype, the ends of these leads were terminated in miniature hook connectors. It's a good idea to label each lead with the number corresponding to its input channel.

Software

The software comes on three floppy discs and runs under Windows 3.1x, Windows 95 and Windows NT. It's easy to install – all you have to do is run the setup.exe file on the first disc (within Windows) and follow the on-screen instructions. In Windows 95, you click Start, Run and then type A:\setup.exe in the space provided (assuming that the floppy disc is in the A: drive).

In Windows 3.1x, you click File, Run and type in A:\setup.exe. Alternatively, you can double-click the setup.exe file from the File Manager or, in Win95, from the Explorer.

When you boot the software, you get the screen display shown in Fig.1. Note that the meters and digital readouts will all overrange if the device is unplugged from the parallel port. If any channel overranges, its channel number button turns red. **SC**

Where To Buy Parts & Software

Parts and software for this design are available as follows:

(1). MC145041 (TLC542) 8-bit A/D converter $4
(2). MAX192 10-bit A/D converter $20
(3). MAX186 12-bit A/D converter ..... Call
(4). Software for 8-bit A/D converter (three discs) $20
(5). Software for 10-bit & 12-bit A/D converters (three discs) $25
(6). Optional LPT2 card for PC $15

Please add $5 for postage. Payment by cheque or money order only to: Mr Softmark, PO Box 1609, Hornsby, NSW 2077. Ph/fax (02) 9482 1565.
Note: the software associated with this design is copyright to Mr Softmark.

Flickering Flame

By ROSS TESTER

THEATRICAL PRODUCTIONS often call for flaming torches and similar lighting effects. The problem is that for fairly obvious safety reasons most theatres and halls have very strict rules regarding the use of naked flames on stage. In fact, in most halls, naked flames are taboo.

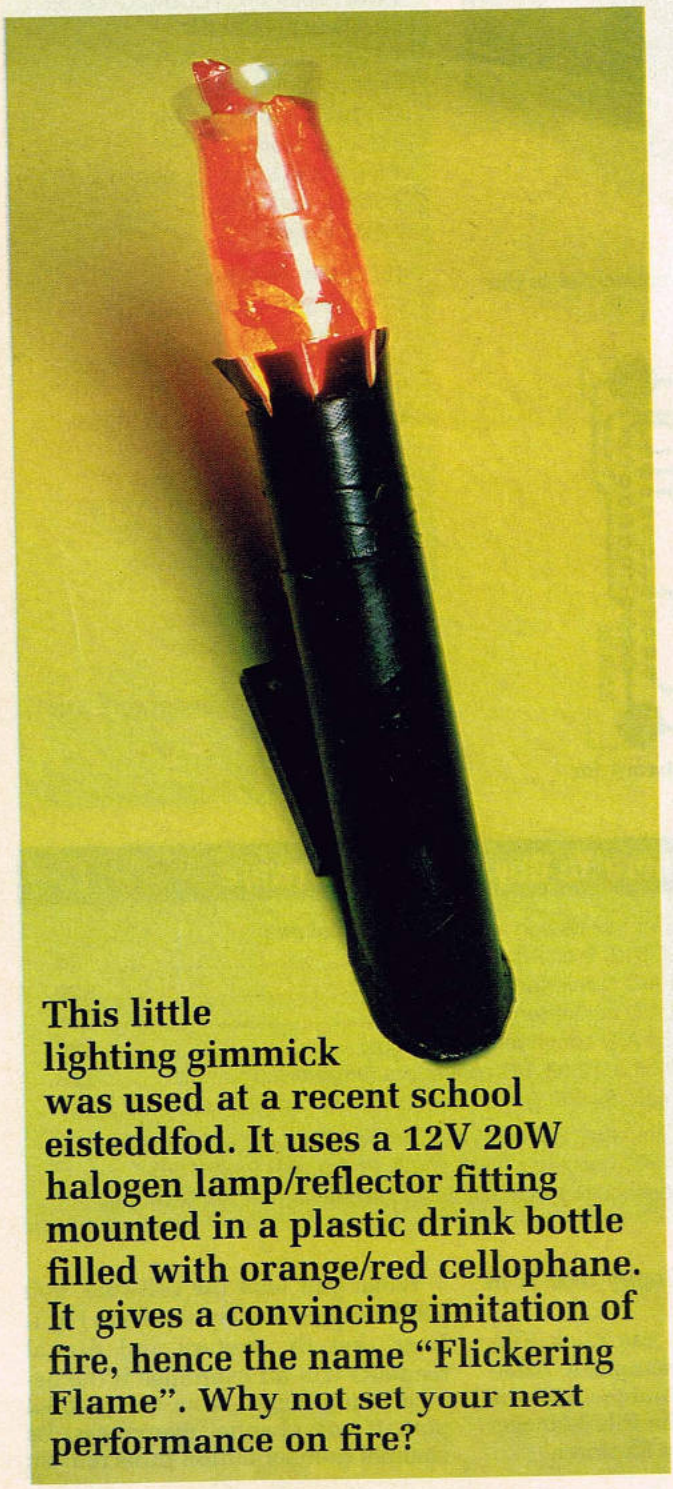
We had just this situation recently when our local high school needed some props for its Rock Eisteddfod act. One scene was a castle wall lit by flaming torches – except they couldn't have flames! Also they (and the Rock Eisteddfod itself) had a couple of other curly requirements which made life just that much harder!

For example, mains power was not an option because the props on which the flaming torches were placed were to be moved to various positions on the stage. And the lights themselves needed to be completely portable because the props were stored offstage and assembled in a rush!

One other request was that they had to cost as close to nothing as possible and be reasonably sized – not too big to get in the way but conversely not too small either. And they had to look realistic!

For those not familiar with the Rock Eisteddfod, perhaps a word or two of explanation is in order. The challenge is open to all secondary schools and entails an act of dance and drama set to contemporary recorded music.

The act itself can be no more than eight minutes and most importantly, any set or props used must be capable of being brought onto stage and set in less than four minutes (and conversely, removed in the same time). There are strict limits on the amount of money a school can spend and there are also limits on the number of



This little lighting gimmick was used at a recent school eisteddfod. It uses a 12V 20W halogen lamp/reflector fitting mounted in a plastic drink bottle filled with orange/red cellophane. It gives a convincing imitation of fire, hence the name "Flickering Flame". Why not set your next performance on fire?

***LEFT:* it mightn't look too spectacular up close and as a still photo but from an audience viewpoint it looks just like the real thing when it is working.**

backstage crew allowed to assist the "performers".

Those who have never seen a Rock Eisteddfod performance before marvel at the spectacle, the professionalism, the choreography, the costumes and the props.

Ah, the props. This is where we came in, with a request to help out with those flaming torches (no pun intended!). The props people at the school had come up with the basic design for the torch (and as you will see, it's amazing what you can get away with from a distance!). What they wanted was something to make them flicker.

"Easy", we thought. First of all we looked at a real flickering flame (a candle, to be precise). Effectively, the "light" was on all the time but every now and then it dimmed a bit as the flame was caught by a breeze. All we needed to do was emulate that. A microprocessor could easily be programmed to do the job nicely.

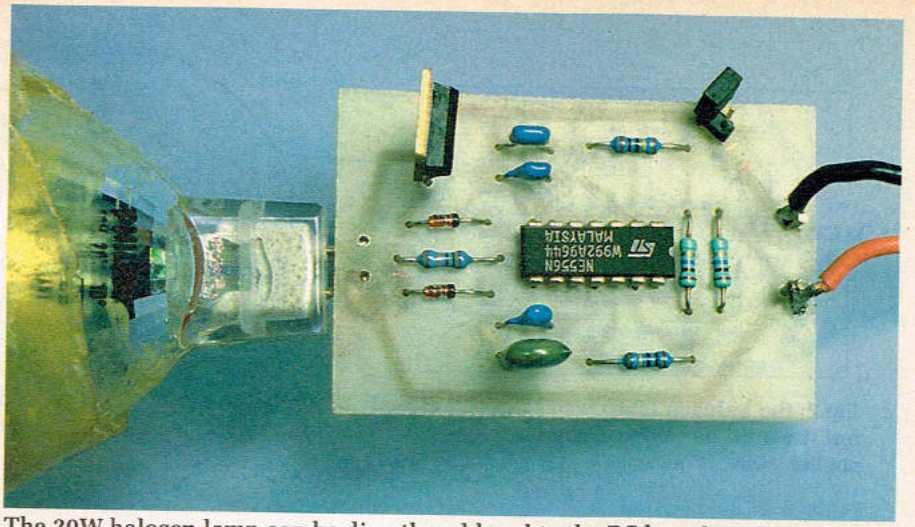
"Whooaa! Too expensive", they said. OK then, how about a 555 timer configured as an astable multivibrator driving a cheap power Mosfet? You couldn't get much cheaper than that!

The problem with that idea was that while it certainly flickered the lights, it was far too regular: looked more like a flamin' lighthouse than a flaming torch!

What about two 555 timers running at different, unrelated frequencies? Would this give the random effect we wanted? We tried this idea and . . . sure would! Calculating values gave us roughly the right oscillation rates, trial and error gave us the effect we wanted. Fig.1 shows the final circuit.

The duty cycle (on time to off time) is set by the ratios of R1 to R2 and the oscillation rate is set by R1 and R2 in conjunction with C1. The duty cycles were set very high – around 10:1. Any longer than this and the lights actually went right off – not very realistic at all! The oscillation rate was set at about 1Hz or longer.

The values of R1 & R2 are significantly higher than one might "normally" expect to be used in 555 circuits. The reason for this is that high values of resistance allow low values of capacitance. A high value resistor costs the same as a low value resistor while a high value capacitor costs significantly more than a low value unit. We used the same values for R1 & R2



The 20W halogen lamp can be directly soldered to the PC board as shown here, or connected via flying leads. The component at top right of the PC board is a pair of header pins with a shorting link – this formed our on/off switch.

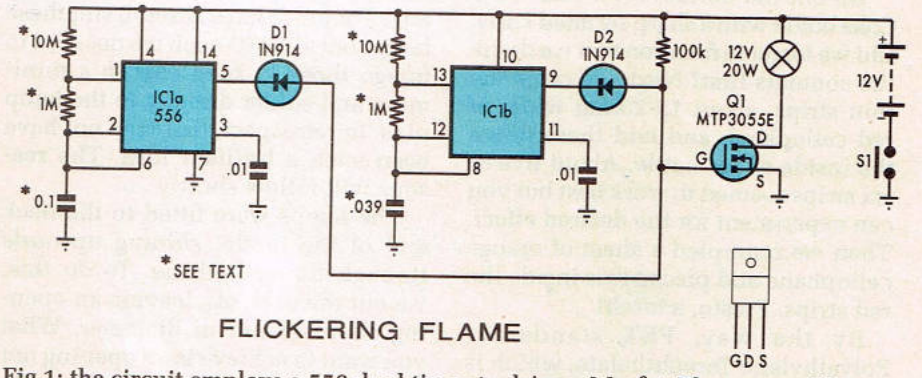


Fig.1: the circuit employs a 556 dual timer to drive a Mosfet. The two oscillators run at different rates to give a random flickering effect from the halogen lamp.

in the two oscillator circuits but picked different capacitor values to ensure that the operating frequencies were not too close together.

While on the subject of costs, we looked at the lolly shop catalogs and found that a 556 (two 555s in one package) was a few cents cheaper than a pair of 555s, so we went this route.

The outputs of both astable oscillators are fed to a diode "OR" gate and these feed the gate of the Mosfet. In effect, the difference between the two oscillators is fed to the Mosfet gate. What happens is that when either of the oscillator outputs goes low, one of the diodes is forward biased, taking the Mosfet's gate low.

When the gate is taken high, which will be most of the time, the Mosfet is turned hard on and is a very low resistance. Therefore, the lamp lights at full brilliance.

When the Mosfet gate is pulled low by either of the oscillator outputs, the Mosfet turns off, turning off the lamp. But because of the very short "off" time and the thermal inertia of the lamp filament, it doesn't actually turn off but flickers. So we have random flickering of the lamp, which is just what we want.

Viewed up close, it doesn't look all that impressive. From more than a few metres away though, the effect is quite convincing – there's fire in that thing!

In the end, we made quite of few of these torches, varying the timing capacitors in each to ensure they never flickered "in sync".

Making the torch

You would be surprised at how much you can get away with in designing props! Looking at the photograph, you'll see that our torch appears exactly what it is: crumpled cellophane in a plastic drink bottle, fitted to a length of cardboard tube. But

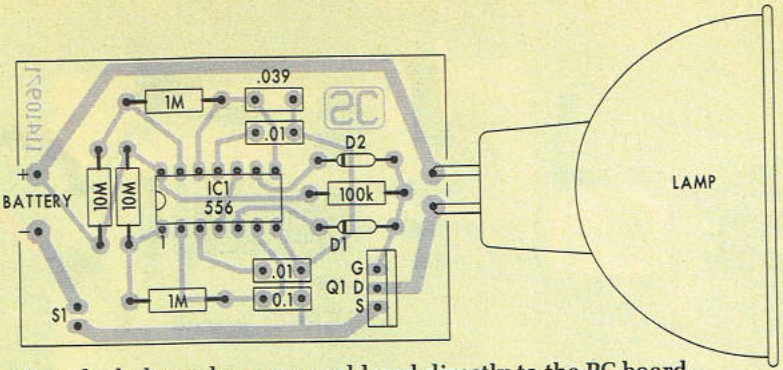


Fig.2: the halogen lamp was soldered directly to the PC board but it would be easier if you used a standard halogen lamp socket base.

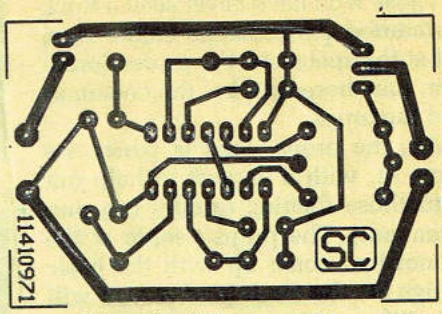


Fig.4: this is the full-size etching pattern for the PC board.

to the audience, it looks just like a flaming torch!

We cut the bottom off a PET 1.25l Coke bottle with a sharp serrated knife. Did we forget to mention that we drank the contents first? Next, we cut some thin strips, about 15-20mm wide, of red cellophane and laid these down the inside of the bottle. About five or six strips seemed to work best but you can experiment for the desired effect. Then we crumpled a sheet of orange cellophane and placed this inside the red strips. Presto, a torch!

By the way, PET stands for Polyethylene Terephthalate, which is the long-winded moniker for polyester. Now you know.

The other end of the bottle was removed to suit the lamps used. We mentioned safety before as this was a major concern. The lamp we used was especially chosen for the job: a 12V 50mm diameter halogen type with dichroic reflector, normally used in low voltage downlights or shop display lights.

However, we used a specific type. Most 12V downlights have a 50 watt rating; we used a 20 watt type to keep heat to a minimum. And to ensure that the hot halogen lamp would not be able to ignite the cellophane (we've seen that happen before!) we chose a lamp with an integral clear glass cover.

Should these lamps not be available at your normal shop Jaycar stores have them (Cat No SL-2732). They are coded "BAB" on the reflector, indicating that they have a beam width of 38 degrees which is pretty well optimum for this job.

Their price is right, too at $4.95 each (we were quoted $15 each at a lighting store!) Incidentally, Jaycar have a similar 12V/20W lamp just 35mm in diameter if space is a problem. They also have bases to suit these lamps but at $2.95 each we decided to forego these to keep cost to a minimum and solder directly to the lamp pins. In retrospect, that may not have been such a brilliant idea. The reasons will follow shortly . . .

The lamps were fitted to the neck end of the bottle, shining upwards through the cellophane. To do this, we cut the neck off, leaving an opening about 25mm in diameter. What you want to achieve is an opening not too large for the lamp to slip through.

We used contact adhesive to hold the lamp in place. Yes, the lamp does get rather hot; in fact, enough to distort the PET bottle but we were able to operate our torches for half an hour or more without any problems.

Allow the adhesive to dry completely. While this is happening, you can fashion the mounting hardware. We used 100mm cardboard tube long enough to take the battery pack (see below) and the lamp itself. Eight slots were cut in the tube, about 40mm down from the top, which allowed the lamp to be simply pushed into place.

This view shows the 20W halogen lamp and its integral reflector.

It is quite important that the tube be made deep enough to ensure that no white light can be seen by the audience – this ruins the effect completely.

We said before that our idea was to solder the pins of the lamp directly to the PC board. This is not quite as simple as it seems the pins simply did not want to solder! They're probably nickel plated or similar which is certainly not designed for ease of soldering.

Eventually, after much scraping of the pins and with a very hot iron we were able to make a soldered joint but this was definitely the weakest link in the chain. If you can afford to invest another couple of dollars in the bases, they would make life much easier.

The circuit is designed to operate from 12V DC. The electronics drain is negligible but the lamp itself draws the best part of 2A (ie, 20W/12V). We used a battery pack made of six 2.5A SLA rechargeable cells (mainly 'cos the school had these on hand), giving an operating time of more than an hour. As the whole Rock Eisteddfod performance was over in eight minutes, this was more than enough. If you need longer times, you will need a suitably larger battery.

Assembling the PC board

We designed a PC board to suit the project. It is coded 11410971 and measures 58 x 38mm. This is quite straightforward to assemble as the only polar-

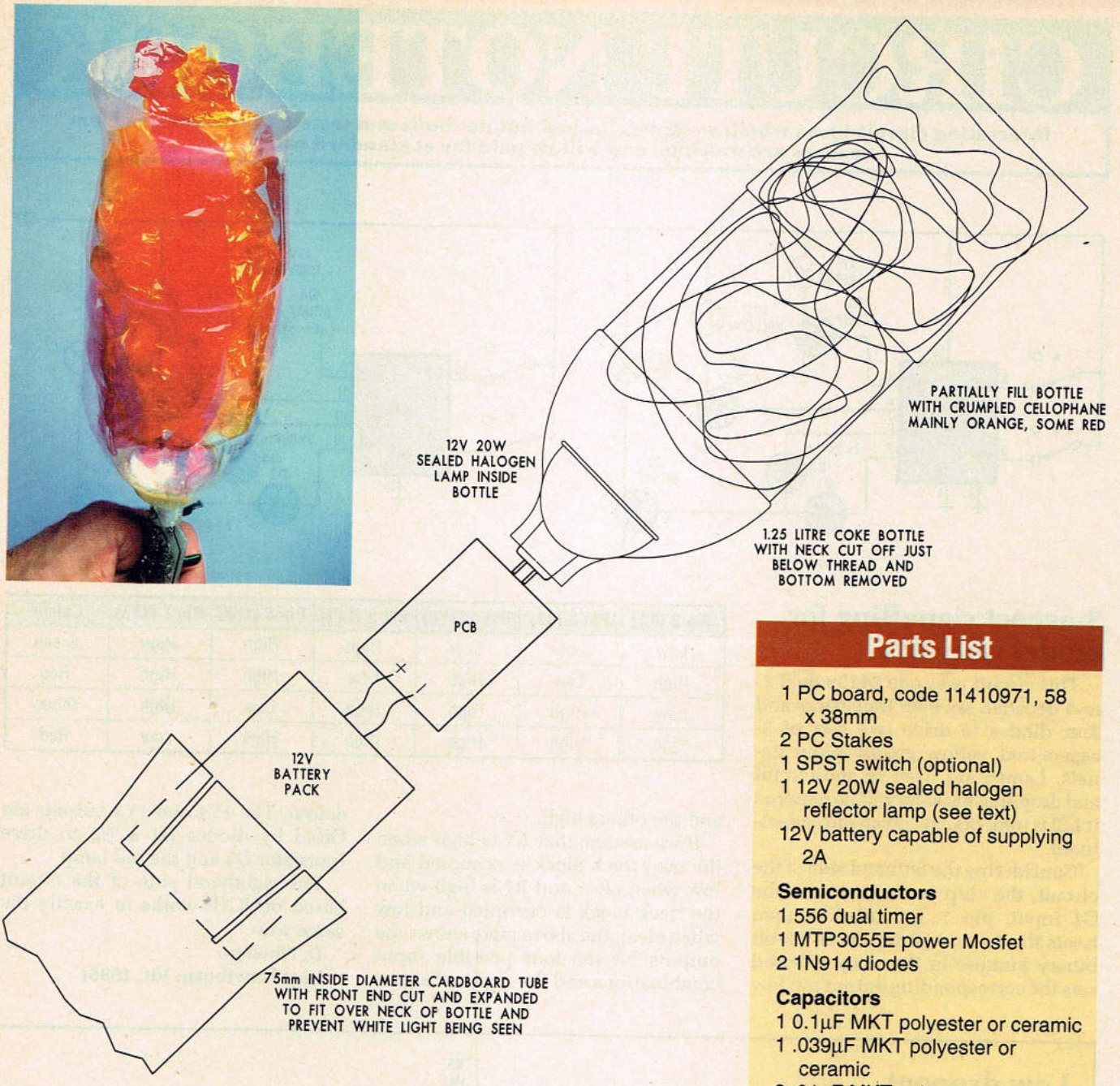

PARTIALLY FILL BOTTLE WITH CRUMPLED CELLOPHANE MAINLY ORANGE, SOME RED
12V 20W SEALED HALOGEN LAMP INSIDE BOTTLE
1.25 LITRE COKE BOTTLE WITH NECK CUT OFF JUST BELOW THREAD AND BOTTOM REMOVED
PCB
12V BATTERY PACK
75mm INSIDE DIAMETER CARDBOARD TUBE WITH FRONT END CUT AND EXPANDED TO FIT OVER NECK OF BOTTLE AND PREVENT WHITE LIGHT BEING SEEN

Fig.3: this diagram shows the overall scheme. The battery and PC board/lamp assembly is mounted in a cardboard tube with the lamp illuminating a PET soft drink bottle filled with crumpled cellophane.

Parts List

1 PC board, code 11410971, 58 x 38mm
2 PC Stakes
1 SPST switch (optional)
1 12V 20W sealed halogen reflector lamp (see text)
12V battery capable of supplying 2A

Semiconductors
1 556 dual timer
1 MTP3055E power Mosfet
2 1N914 diodes

Capacitors
1 0.1µF MKT polyester or ceramic
1 .039µF MKT polyester or ceramic
2 .01µF MKT polyester or ceramic

Resistors (0.25W, 1%)
2 10MΩ
2 1MΩ
1 100kΩ

ised parts are the IC, Mosfet and diodes. Make sure you get these right, along with the battery connections

Therefore, construction is very simple – apart from soldering the lamp, as mentioned above. We made provision for an on/off switch on the board or you could simply connect and disconnect the battery as required.

Before you solder in the Mosfet and the lamp, you can check the operation of your circuit with an analog multimeter. Apply 12V and check the voltage at pins 5 & 9 of the IC using a multimeter (set to measure 12V DC). At both pins, you should see the meter dipping regularly – but not down to zero volts, unless you have chosen a much higher value resistor for R2.

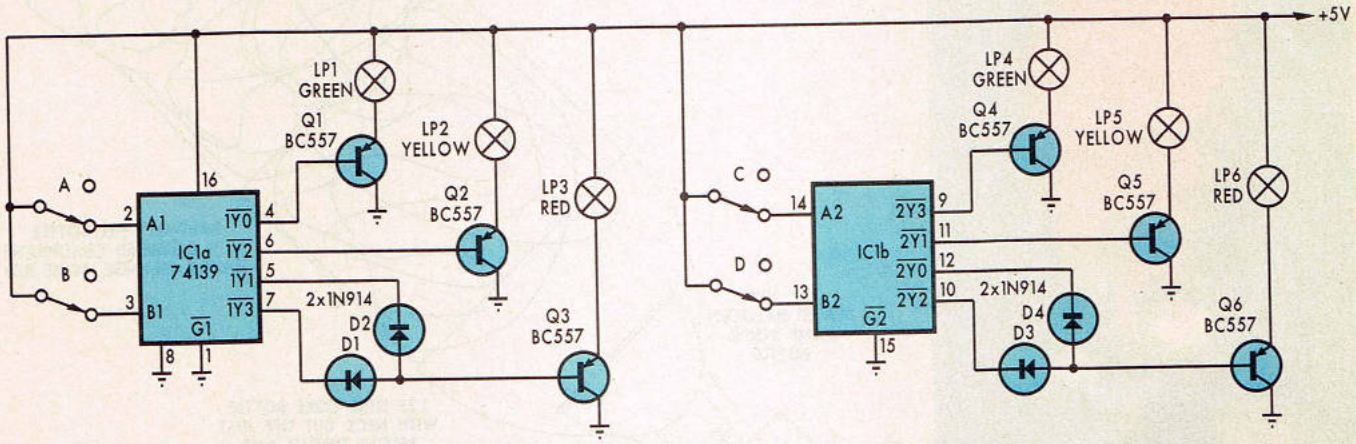
When you measure at the junction of the two diode anodes, you should see the meter dipping more or less randomly, indicating that the two outputs are being added, or rather subtracted, through the diodes.

With the 20W lamp suggested, a heatsink for the FET is not really necessary. It does get reasonably warm to touch but should be quite happy at this level.

Do not use a 50W lamp. There is no doubt that it will melt the PET bottle and it could well set fire to the cellophane. **SC**

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



3-aspect signalling for model railways

This circuit uses one 74139 dual 2-to-4 decoder, six PNP transistors and four diodes to drive two sets of 3-aspect (red, yellow, green) colour signals. Lamps are used in the circuit and dropping resistors will be required if LEDs (red, orange, green) are substituted.

Considering the lefthand side of the circuit, the chip is enabled with the G1 input, pin 1, grounded. It then treats the A1 and B1 inputs as a 2-bit binary number in the range 0-3 and sets the corresponding output pin low and the others high.

Pin 2 (A1)	Pin 3 (B1)	Pin 4 (1Y0)	Pin 5 (1Y1)	Pin 6 (1Y2)	Pin 7 (1Y3)	Colour
Low	Low	Low	High	High	High	Green
High	Low	High	Low	High	High	Red
Low	High	High	High	Low	High	Yellow
High	High	High	High	High	Low	Red

If we assume that A1 is high when the next track block is occupied and low when clear and B1 is high when the track block is occupied and low when clear, the above table shows the outputs for the four possible input combinations and the required signal colour. The 1Y1 and 1Y3 outputs are ORed by diodes D1 & D2 to drive transistor Q3 and the red lamp.

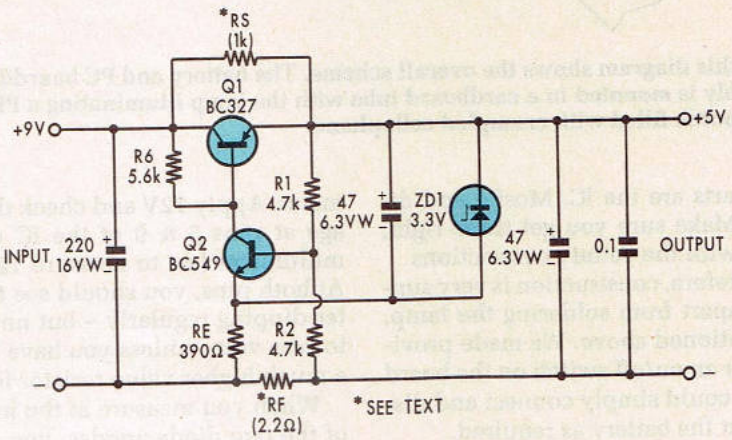
The righthand side of the circuit based on IC1b works in exactly the same way.

D. Nowlan,
East Hawthorn, Vic. ($35)

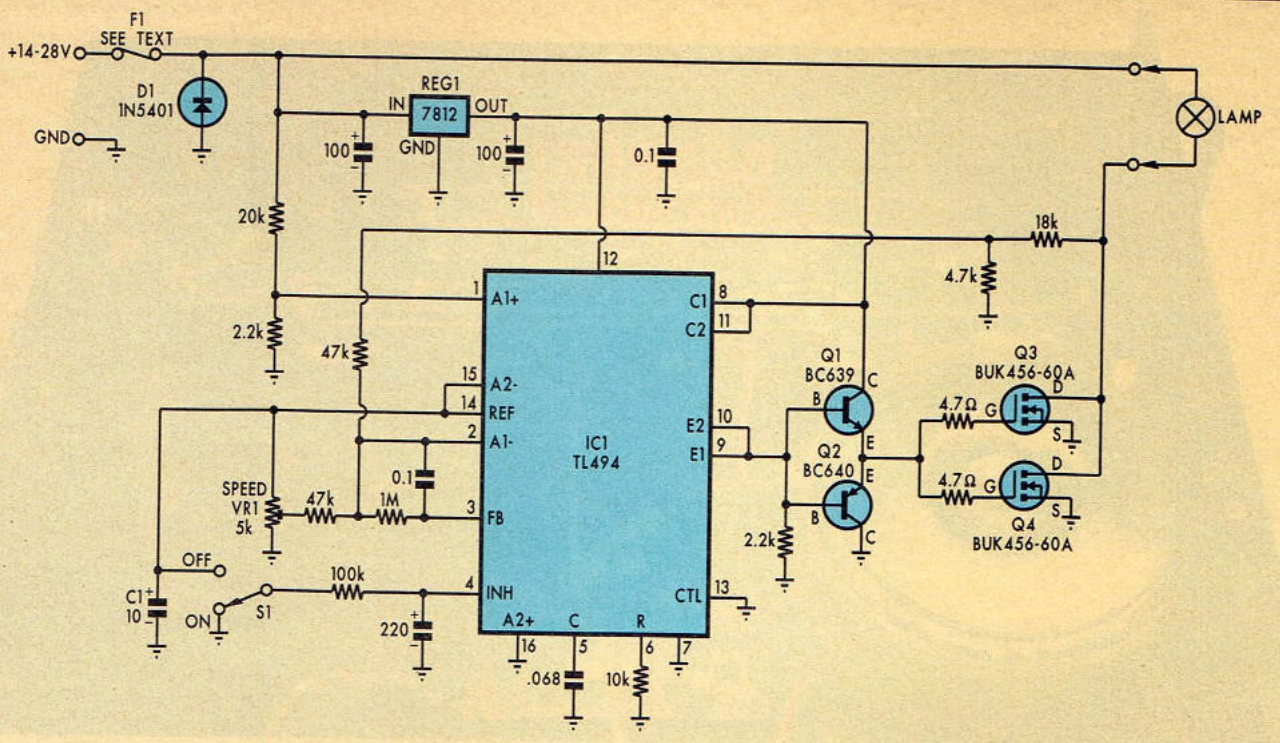
Low dropout 5V regulator

This regulator has been designed to run 5V circuits from 9V dry batteries. These batteries exhibit a gradual voltage reduction during their useful life, from just above 9V when fresh to about 5.5V at the end-point. This circuit has a dropout of just 0.6V, enabling the full battery life to be obtained for a maximum load current of 100mA.

Common features of all low-dropout regulators are that the main series transistor works as a common-emitter amplifier (as opposed to



Q1 works as a common emitter amplifier and is driven by error amplifier Q2.



Using the 12/24V speed controller as a dimmer

A number of readers have requested modifications to allow the 12V/24V motor speed controller published in the June 1997 issue to be used as a dimmer. This is easily accomplished by a modification to the "soft start" feature in the original circuit, involving the Inhibit input, pin 4.

If pin 4 is held high, the output drive signals at pins 9 & 10 are inhibited. In the original (June 1997) circuit, a 10µF capacitor (C2) initially holds pin 4 high and as it charges, pin 4 drops to zero and gradually allows the output pulse width at pins 9 & 10 to increase to the required width.

In this modified circuit, we have omitted C2 and instead connected a 220µF capacitor at pin 4 to give a controlled "dim up" or "dim down" function, as selected by switch S1. When switch S1 is off, pin 4 is held high (ie, at $+V_{REF}$) by the 100kΩ resistor. When the switch is moved to on, the 100kΩ resistor discharges the 220µF capacitor at pin 4. The lamp load is then dimmed up to the setting selected by trimpot VR1. Longer dimming times can be obtained by increasing the value of the 220µF capacitor.

Note that if power applied to the circuit with switch S1 in the on position, the full load voltage will be applied to the lamps, with no soft start.

SILICON CHIP

emitter follower configuration in standard regulators) and the load current is only a fraction of its maximum collector current. Because of this, transistor Q1's collector-to-emitter saturation voltage is very low.

Q1 is driven by Q2 working as an error amplifier. R6 ensures that its collector current doesn't fall below 100µA. It uses metal film base bias resistors (4.7kΩ) in order keep the output noise voltage low.

The reference zener diode ZD1 is connected between the output and emitter of Q2. Q2 compares a sample of the output voltage at its base with the zener reference voltage at its emitter.

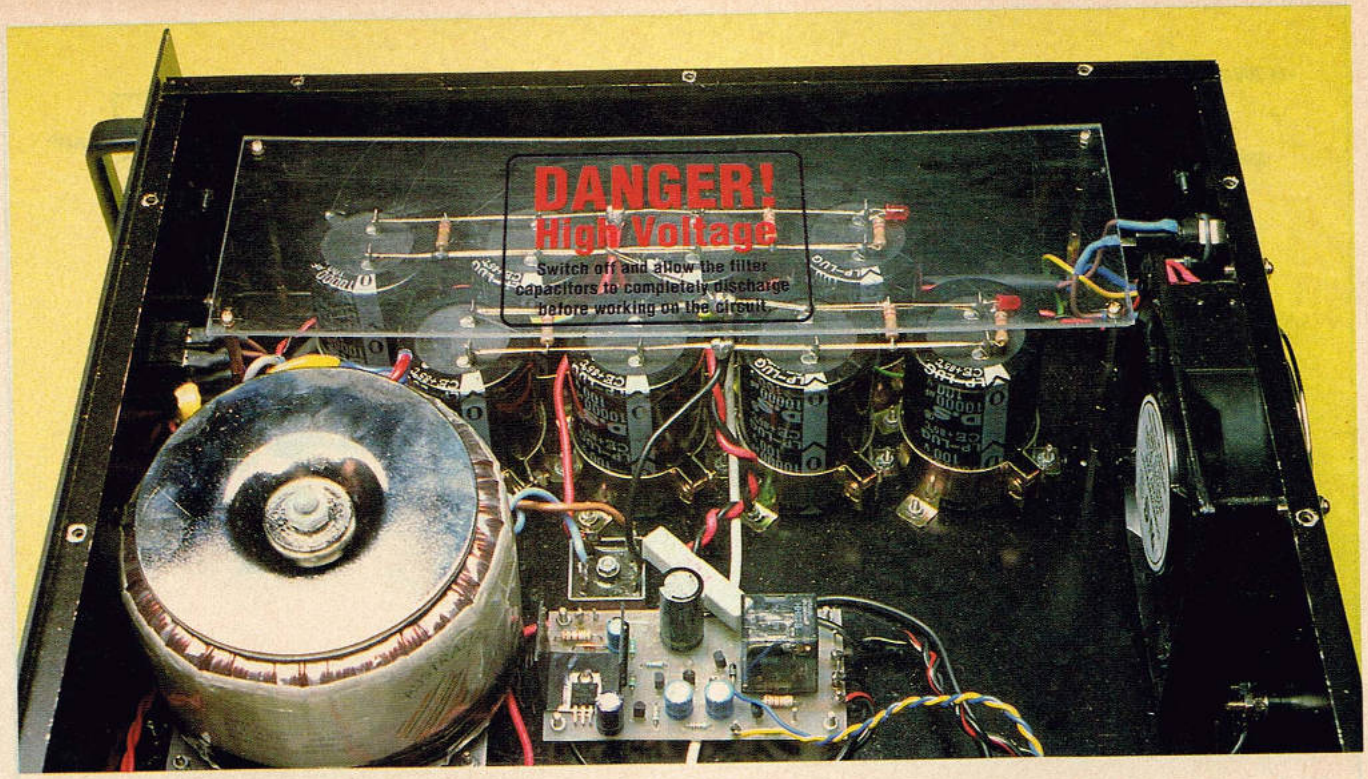
Because of the low amplification factor of the error amplifier and additional losses due to the zener diode's internal resistance, the positive feedback resistor Rf has been included. A startup resistor (Rs) is also necessary to deliver initial base current to Q2.

The values of resistors Rs and Rf had to be found empirically, with Rs being the minimum value at which the regulator would power up with the maximum load connected to it and when supplied by the lowest designed input voltage. Rf must be such as not to give the regulator a negative output resistance (ie, an increase of output current causing any increase of output voltage) over any part of its output current range.

The prototype has been tested and gave the following results: minimum dropout voltage 0.6V @ Iout = 100mA (100mV @ Iout = 10mA); line regulation below 20mV @ Vin + 5.6-9V, Iout = 100mA; load regulation below 5mV @ Iout = 5-100mA.

Note that the regulator does not have overload protection.

M. Frankowski,
Warsaw, Poland. ($35)



Part 3: building the

500W Audio Power Amplifier

In this final article on the 500W audio power amplifier, we present the details of the loudspeaker protector module and the thermal switch for the fan.

By LEO SIMPSON & BOB FLYNN

As we left the power amplifier last month, supposing you were building it, you had just had the module on "heat soak" for about an hour to check the quiescent current setting. This is set by adjusting trimpot VR2 so that the voltage across the 390Ω 5W resistors (temporarily installed across fuses F1 and F2) is 30V. After the initial setting, the voltage will creep up quite a bit, perhaps to 45V or more, so it is necessary, to readjust trimpot VR1 to bring the voltage back to 30V.

It is important to note that the thermal compensation provided by the Vbe multiplier transistor (Q9) does not give perfect compensation for the drift in quiescent current. Even after you have tweaked it a number of times, it will still drift about. Of course, if the thermal compensation wasn't included in the circuit, the quiescent current would rapidly go out of control as soon as the amplifier was called upon to deliver significant power.

Having set the quiescent current to your satisfaction, you can now set the DC offset current at the output, by adjusting trimpot VR1. You need a digital multimeter for this test. Set it to the lowest available DC voltage range, probably 200mV, and connect it directly across the output terminals on the PC board. Adjust VR1 to obtain zero volts. You should be able to get it to within ±1mV although again, it will tend to drift about.

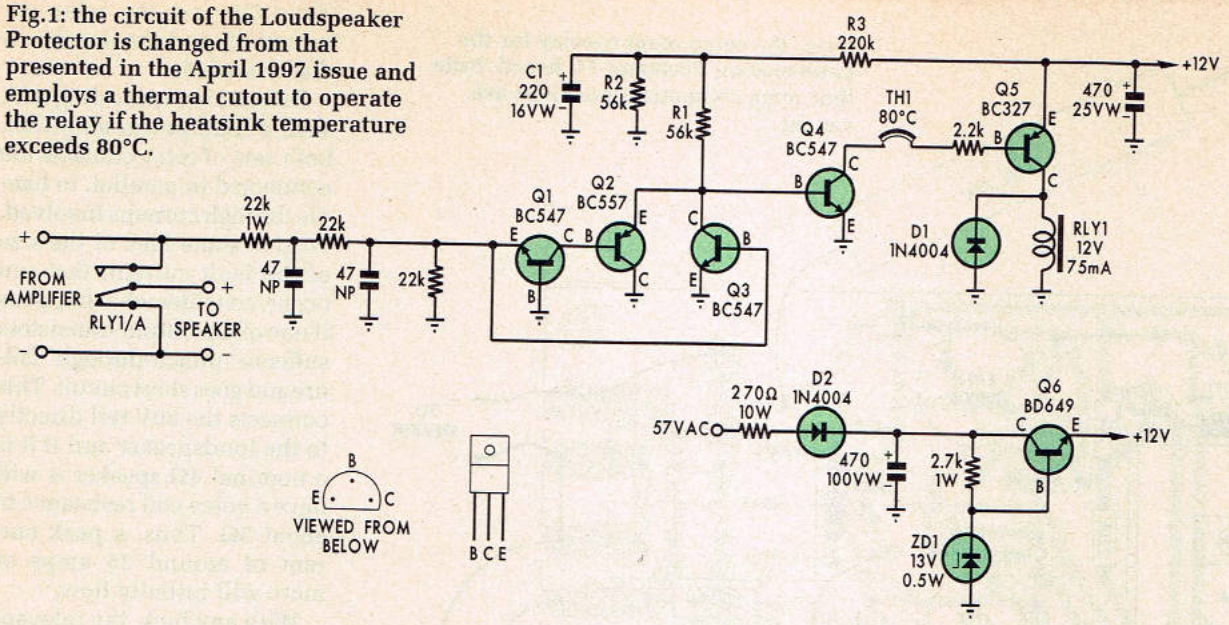


Fig.1: the circuit of the Loudspeaker Protector is changed from that presented in the April 1997 issue and employs a thermal cutout to operate the relay if the heatsink temperature exceeds 80°C.

In practice, the DC offset voltage or its drift is not important if you are driving a 4Ω or 8Ω load. Even if the DC output offset went as high as ±50mV, the current would still be less than 20mA through a 4Ω loudspeaker and that is negligible in the overall scheme of things.

The main reason we have included the offset adjustment trimpot (VR1) is so that the amplifier can be used to drive one or more 100V line transformers. Because such transformers have a very low primary resistance, the resulting DC offset current from a 50mV DC offset being present at the output could be considerable. The current could lead to substantial power dissipation in the amplifier and could lead to premature saturation of the transformer itself, resulting in less power delivered and higher distortion.

Loudspeaker protector

Now that we have come this far, we can turn our attention to the Loudspeaker Protector PC board. The circuit of this is shown in Fig.1. This is based on the Universal Loudspeaker Protector we presented in the April 1997 issue but inevitably, we have modified it. The original circuit was designed to suit a stereo amplifier and since this is a mono amplifier we have omitted three transistors and the other components needed for the second channel.

Second, we have changed the method of powering the board. The method we had intended using involved running the module from the +80V DC rail via a 470Ω 10W wirewound resistor and using the on-board regulator circuit to obtain 12V for the relay and so on. This method works but there is a problem with the time delay between the amplifier being turned off and the relay actually disconnecting the loudspeakers.

This problem arises because of the large amount of capacitance in the filter bank – 40,000µF on each rail. This capacitance takes quite a long time to discharge, particularly if the amplifier is not delivering any power at the time it is turned off.

The solution is to power the Loudspeaker Protector module from the 57VAC supply via a 270Ω 10W wirewound resistor. This feeds the AC supply to the PC board and to a diode and 470µF filter capacitor to provide a DC supply. This is shown on Fig.1. With this arrangement, the derived DC supply drops rapidly to zero as soon as the amplifier is turned off and so the speaker is disconnected almost immediately.

The other difference between the circuit presented here and the original circuits shown in the April 1997 issue is that we use a thermal cutout switch to control the relay.

This is a different arrangement to that shown on the prototype amplifier module in the photograph on pages 24 & 25 of the August 1997 issue. That showed the thermal cutout switch mounted on the heatsink and connected in series with the loudspeaker output.

Having the thermal cutout in series with the amplifier's output would be appropriate if the Loudspeaker Protector module was not being used but we don't want two sets of contacts in series with the loudspeaker; ie, the thermal cutout and the relay contacts. Therefore we connect the thermal cutout so that it operates the relay and that means that only the relay contacts are in series with the loudspeaker circuit.

Note that the thermal cutout switch has a pair of "normally closed" con-

Warning!

The 160V DC supply across the capacitor bank in the power supply is potentially lethal. As well, high voltages exist on the bridge rectifier and on many components in the amplifier module, including the fuseholders. The following rules should be observed:

(1). Do not operate the amplifier without the Perspex shield covering the filter capacitors.

(2). Disconnect the mains plug and allow the filter capacitors time to fully discharge before working on the circuit. The LEDs will go out when the capacitors have discharged to a few volts.

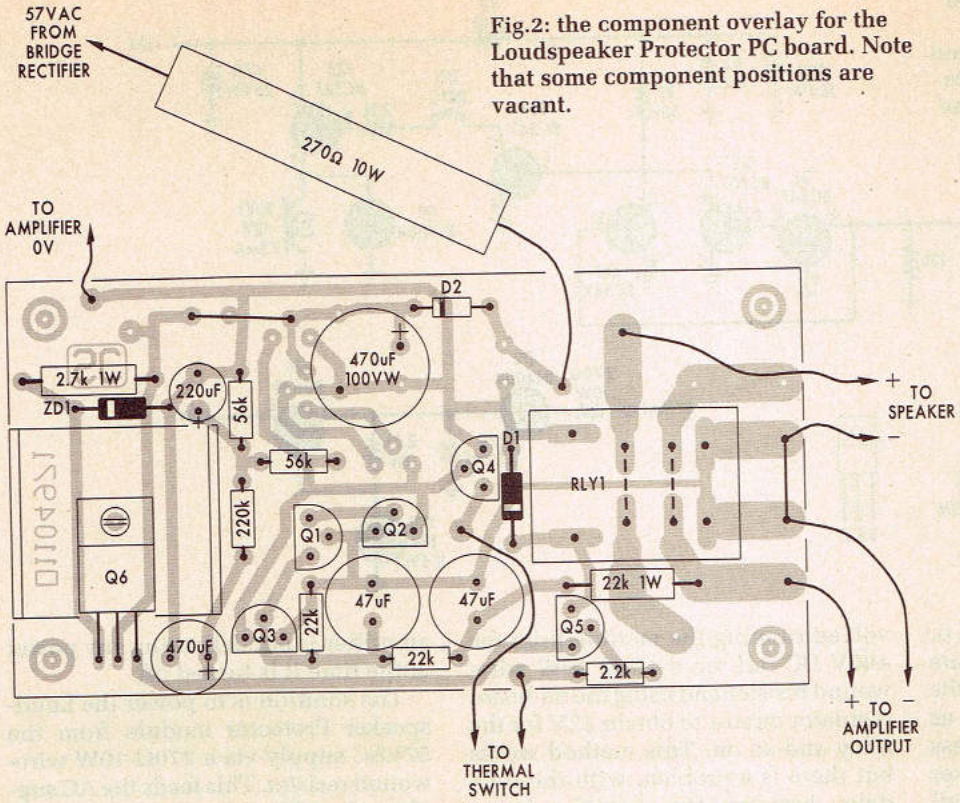


Fig.2: the component overlay for the Loudspeaker Protector PC board. Note that some component positions are vacant.

tacts. When the temperature of its mounting base (ie, the heatsink in this case) rises above 80°C, the contacts open and interrupt the base current to transistor Q4 on the Loudspeaker Protector module.

For the sake of completeness, let's now give a brief description of the Loudspeaker Protector circuit in Fig.1.

The amplifier's output is connected to the three-transistor monitoring circuit via two 22kΩ series resistors and two 47µF bipolar capacitors. This network is a low-pass filter which removes virtually all audio signal. From there, any DC signal is fed directly to the emitter of transistor Q1 and the base of Q3.

If a positive DC signal of more than 0.6V is present (indicating an amplifier fault), Q3 will turn on. In the same way, if a negative DC signal of more than 0.6V is present (again, an amplifier fault condition), Q1 will turn on and this will turn on Q2.

Q2 & Q3 have a common 56kΩ load resistor and this normally feeds base current to Q4. Q4 feeds base current to Q5 and so both of these transistors and the relay are on.

But when an amplifier DC fault occurs, either Q2 or Q3 is turned on to shunt the base current away from Q4. Thus Q5 and the relay are turned off and the speaker is disconnected.

Because we are dealing with such a high power amplifier, both sets of relay contacts are connected in parallel, to handle the high currents involved. To give some idea of the size of the fault current, that can occur, consider what happens if one of the output transistors suffers a "punch-through" failure and goes short circuit. This connects the 80V rail directly to the loudspeaker and if it is a nominal 4Ω speaker it will have a voice coil resistance of about 3Ω. Thus, a peak current of around 25 amps or more will initially flow.

With any luck, the relevant supply fuse will blow but then the amplifier is likely to "latch" in the opposite direction and connect the other 80V rail across the speaker, to give it a double whammy, if it hasn't already been burnt out by the peak dissipation of more than two kilowatts!

As you can see, it is important for the relay to disconnect the speaker very rapidly, before it is damaged.

These very high fault currents will form an arc across the relay as it tries to break the circuit. For this reason, the moving contacts of the relay are shorted to the loudspeaker ground lines. Thus the current is shunted away from the speaker and the fuse(s) blow.

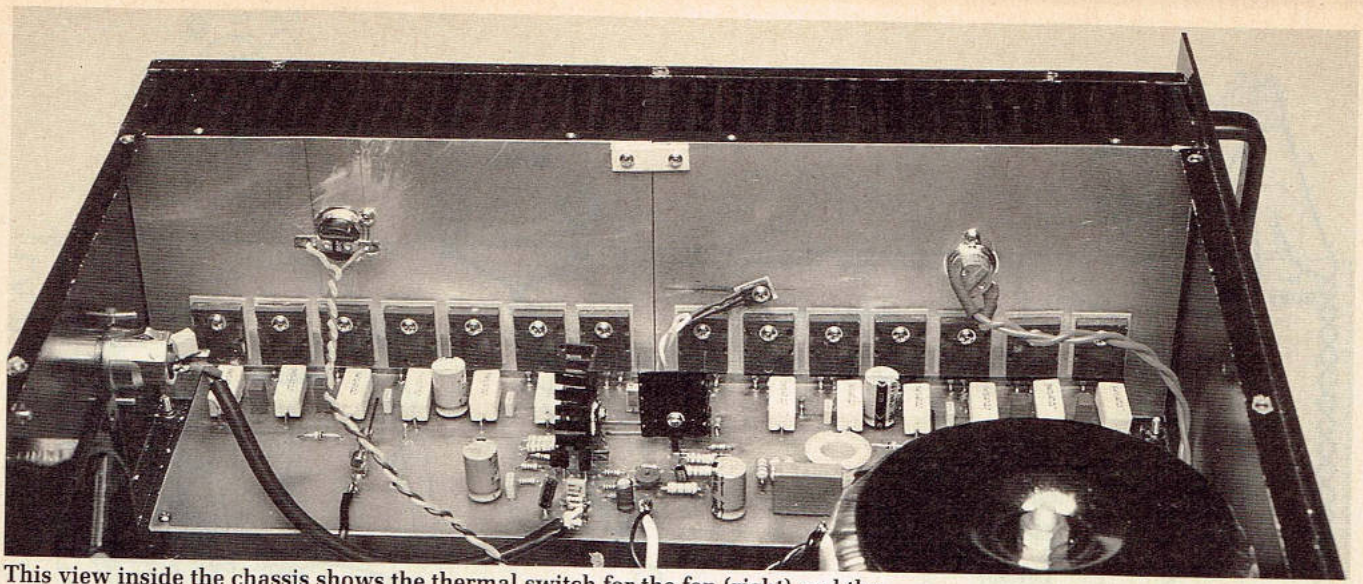
As already noted, the DC supply rail for the Loudspeaker Protector circuit is derived from one of the 57V AC lines from the power transformer. This feeds diode D2 via the 270Ω 10W resistor. The resulting DC rail from the 470µF filter capacitor is fed to transistor Q9 which functions as a voltage regulator to provide +12V to the circuit.

Capacitor Codes

Value	IEC Code	EIA Code
0.15µF	150n	154
0.1µF	100n	104
.01µF	10n	103
820pF	820p	821
100pF	100p	101

Resistor Colour Codes: Loudspeaker Protector Module

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	220kΩ	red red yellow brown	red red black orange brown
2	56kΩ	green blue orange brown	green blue black red brown
2	22kΩ	red red orange brown	red red black red brown
1	2.7kΩ	red violet red brown	red violet black brown brown
1	2.2kΩ	red red red brown	red red black brown brown



This view inside the chassis shows the thermal switch for the fan (right) and the thermal cutout (left) which interrupts the load. The fan operates when the heatsink temperature reaches 60°C, while the load is disconnected at 80°C.

Note that while the relay is off, for example, just after power is applied, the voltage across the 470µF filter capacitor will rise to +80V. That is why we have specified a rating of 100V for this capacitor.

In addition to monitoring DC faults in the power amplifier, the Loudspeaker Protector also provides a turn-on delay for the loudspeaker. This prevents audible turn-on thumps from the amplifier itself or any preamplifier circuitry preceding it. This is achieved with resistors R1 & R3 and capacitor C1.

When power is first applied, C1 is discharged and no base current can flow via the 56kΩ resistor R1 and so Q4 & Q5 and the relay are held off.

C1 then charges via the 220kΩ resistor R3 and eventually sufficient voltage is present to allow resistor R1 to bias on Q4. This turns on transistor Q5 and the relay and so the loudspeaker is connected to the amplifier. The delay is several seconds.

PC board assembly

All the parts, with the exception of the 270Ω 10W resistor, are mounted on the PC board which is coded 01104971. The wiring diagram is shown in Fig.2. Note that some transistor and other component positions are vacant.

Fit the PC pins first and then the resistors. The two 47µF electrolytic capacitors can go in either way around since they are non-polarised (NP or BP). The other electrolytics are polarised and must be inserted the correct way around.

Next insert the transistors, diodes and zener diode and make sure that you put the correct type in each position.

Finally, the relay can be installed. We mounted ours by soldering short lengths of stout tinned copper wire to each relay pin. These wire leads are then pushed through the relay mounting holes on the board and soldered. We understand that some kitset suppliers may provide a PC board with slotted holes so that the tinned copper wire may not be necessary.

When the board is complete, check your work carefully and then install it in the case. The chassis wiring diagram of Fig.3 shows the details. Make the connections for the power supply and the thermal cutout but do not make the speaker connections yet.

Resistor Colour Codes: Power Amplifier Module

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	4	22kΩ	red red orange brown	red red black red brown
❑	2	18kΩ	brown grey orange brown	brown grey black red brown
❑	1	8.2kΩ	grey red red brown	grey red black brown brown
❑	1	1.2kΩ	brown red red brown	brown red black brown brown
❑	1	560Ω	green blue brown brown	green blue black black brown
❑	1	470Ω	yellow violet brown brown	yellow violet black black brown
❑	2	330Ω	orange orange brown brown	orange orange black black brown
❑	4	270Ω	red violet brown brown	red violet black black brown
❑	2	220Ω	red red brown brown	red red black black brown
❑	1	180Ω	brown grey brown brown	brown grey black black brown
❑	1	120Ω	brown red brown brown b	rown red black black brown
❑	5	100Ω	brown black brown brown	brown black black black brown
❑	2	30Ω	orange black black brown	orange black black gold brown
❑	3	18Ω	brown grey black brown	brown grey black gold brown

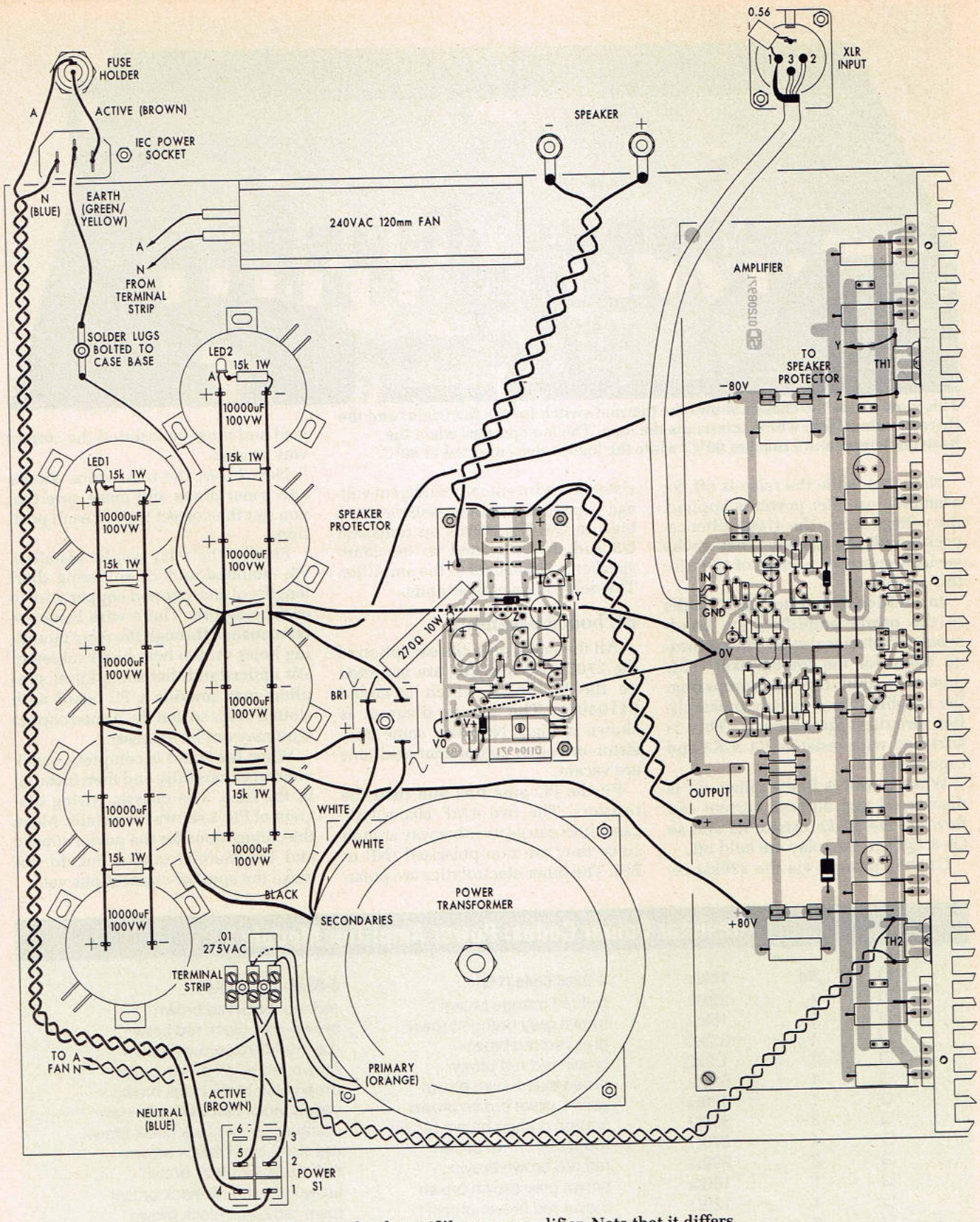


Fig.3: this is the complete wiring diagram for the 500W power amplifier. Note that it differs in detail from that presented last month. Note also that the full DC supply is potentially lethal and that high DC voltages exist on the amplifier supply rails and on may components, including the fuseholders.

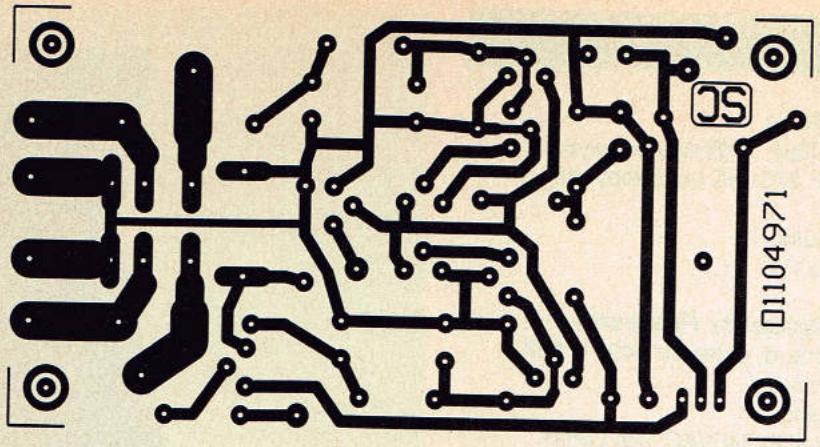


Fig.4: actual size artwork for the Loudspeaker Protector PC board.

DANGER!
High Voltage

Switch off and allow the filter capacitors to completely discharge before working on the circuit.

Fig.5: this warning label should be affixed to the Perspex cover over the filter capacitors in the power supply.

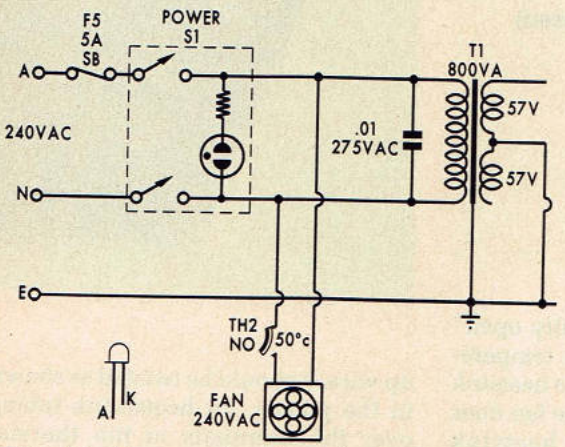


Fig.7: this diagram shows how the fan is wired to the mains via the optional thermal switch.

Apply power and the relay should operate after about two seconds. Next, try simulating an amplifier fault condition with a 6V or 9V battery. Connect the battery across the inputs, first with one polarity and then the other way around. In each case, the relay should immediately open and then close again as soon as the battery is removed.

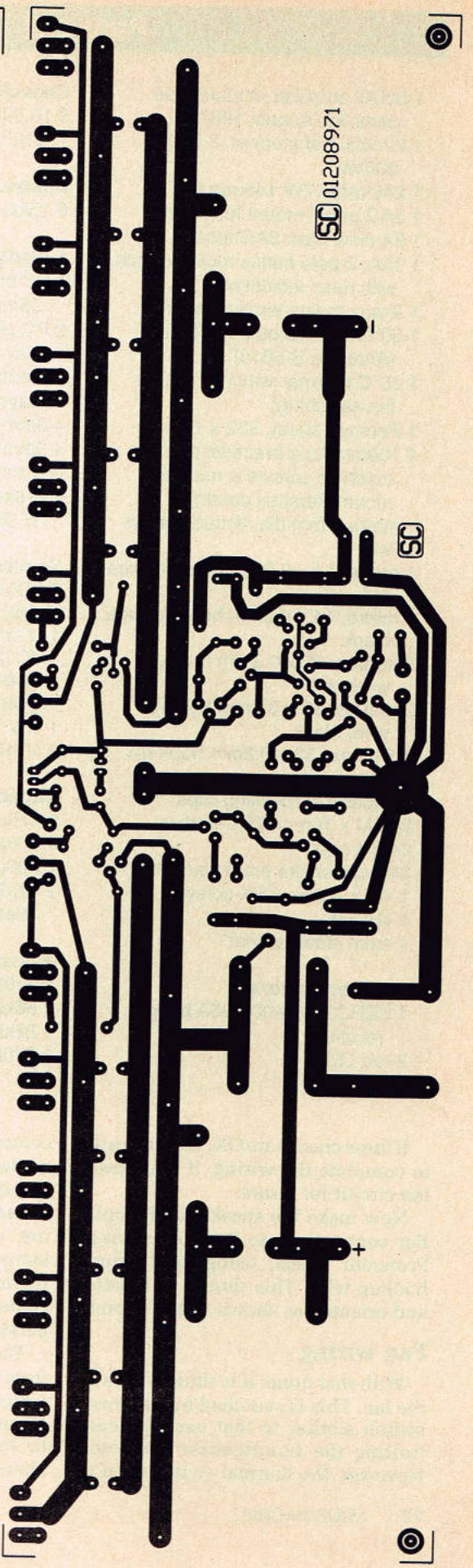


Fig.8 (below): this is the artwork for the amplifier PC board, reduced to 0.707 times actual size. To bring it up to full size, you will need a photocopier which can enlarge by a factor of 1.414.

Parts List

1 500W amplifier module (see parts list, August 1997)
1 toroidal transformer, 2 x 57V, 800VA
1 240VAC 17W 140mm fan
1 3AG panel mount fuseholder
1 5A slow-blow 3AG fuse
1 15A, 2-pole mains rocker switch with neon indicator
1 3-way mains terminal strip
1 80°C thermal cutout (TH1) (Altronics S-5610)
1 60°C thermal switch (TH2; for fan switching)
1 Perspex sheet, 332 x 100mm
4 100mm-long brackets plus machine screws & nuts (to mount Perspex cover)
1 metre, 1mm dia. tinned copper wire
1 metre, 14 x 0.2mm hook-up wire, red
1 metre, 14 x 0.2mm hook-up wire, black
2 metres, 32 x 0.2mm hook-up wire, red
2 metres, 32 x 0.2mm hook-up wire, black
0.5 metre, 32 x 0.2mm hook-up wire, white
8 capacitor mounting clips
24 3M x 10mm CSK screws
24 3M nuts
24 3mm shake proof washers
1 4M x 20mm CSK screw
1 4M nut
1 4mm steel washer

Semiconductors
1 KBPC3504 400V 35A bridge rectifier
2 red LEDs

Capacitors
8 10,000µF 100VW electrolytic
1 .01µF 275VAC polypropylene

Resistors
6 15kΩ 1W

Loudspeaker Protector

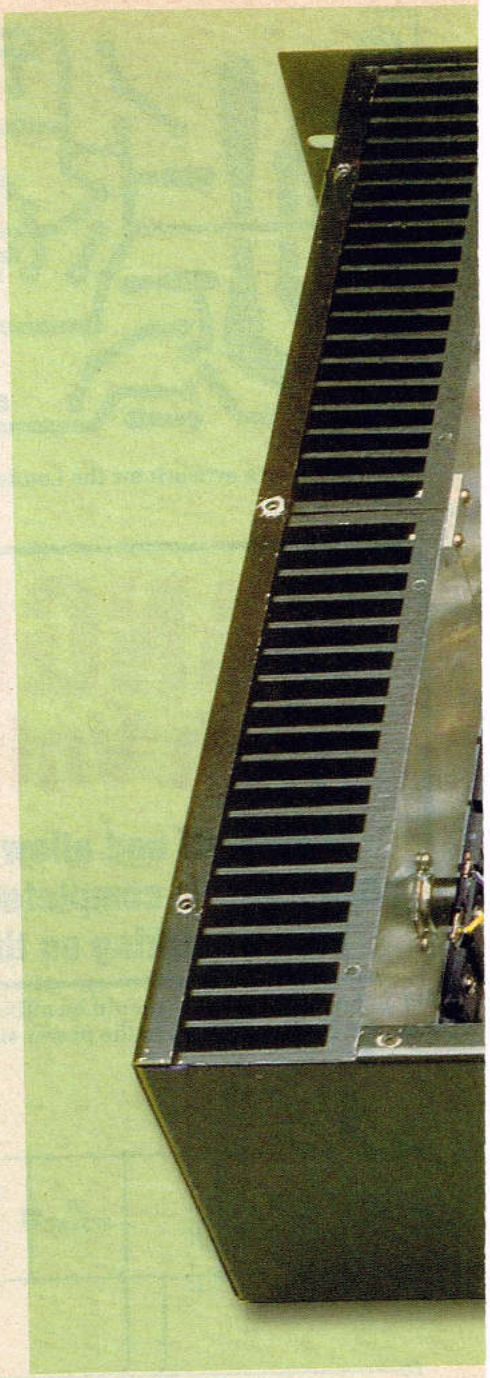
1 PC board, code 01104971, 107 x 55mm
8 PC pins
1 relay with 240VAC 10A DPDT contact, 12V coil @ 75mA, Jaycar SY-4065 or similar
4 3mm x 20mm screws
4 3mm nuts
4 6mm spacers
1 U-shaped heatsink (Altronics Cat H-0502 or equivalent)

Semiconductors
3 BC547 NPN transistors (Q1, Q3, Q4)
1 BC557 PNP transistor (Q2)
1 BC327 PNP transistor (Q5)
1 BD649 NPN Darlington transistor (Q6)
1 13V 500mW zener diode (ZD1)
2 1N4004 silicon diodes (D1,D2)

Capacitors
1 470µF 100VW electrolytic
1 470µF 25VW electrolytic
1 220µF 16VW electrolytic
2 47µF 50VW NP (non-polarised) electrolytic

Resistors (0.25W, 1%)

1 220kΩ	1 2.2kΩ
2 56kΩ	1 2.7kΩ
1 22kΩ 1W	2 22kΩ
1 270Ω 10W wirewound	



If these checks are OK, you are ready to complete the wiring. If not, check the circuit for errors.

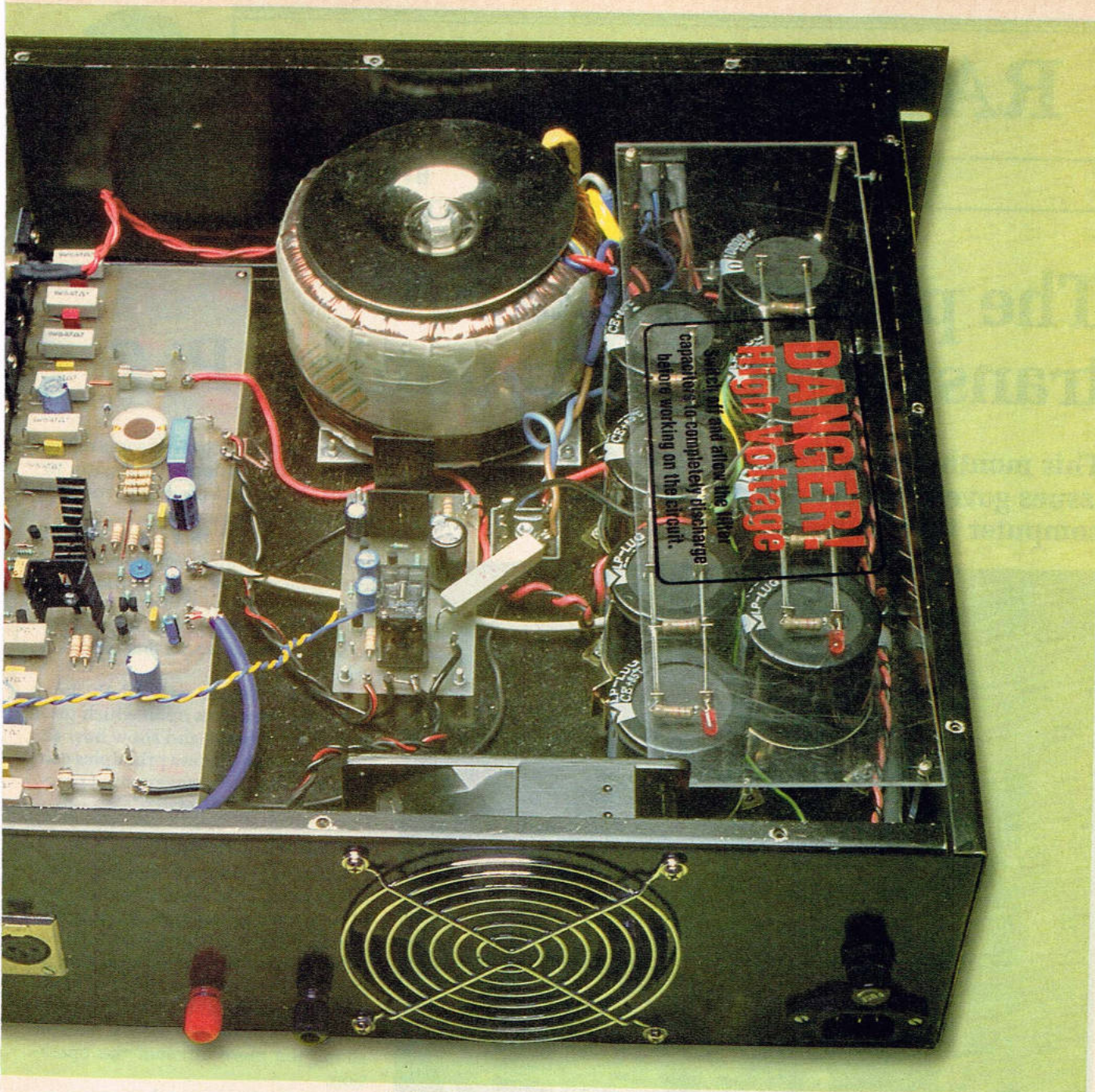
Now make the speaker and amplifier connections to the Loudspeaker Protector board, using heavy duty hookup wire. This should be twisted and oriented as shown in the photos.

Fan wiring

With that done, it is time to wire in the fan. This is switched by a thermal switch similar to that used for controlling the Loudspeaker Protector. However, the thermal switch used to control the fan has "normally open" contacts and operates at a temperature of 60°C. Hence, until the heatsink rises to that temperature, the fan does not operate. When the heatsink temperature does rise above 60°C, the thermal switch will operate and its contacts will stay closed until the temperature drops below 35°C.

The 240VAC supply to the fan comes from the same insulated terminal block which is used to connect the transformer primary winding. The wiring to the thermal switch and the fan should be run in 250VAC-rated hookup wire. It should be twisted as shown in the photos. Fit heatshrink tubing over the terminals of the thermal switch, to avoid the possibility of accidental contact with the 240VAC mains supply.

When all the wiring is complete, apply power and recheck the voltages in the amplifier. Assuming everything is OK, **disconnect the power and wait until the filter capacitors in the power supply have completely discharged (ie, when the LEDs go out).**



This internal view of the completed prototype shows the finalised wiring to the Loudspeaker Protector and the thermal switches on the heatsink. Note that these details are different to the chassis photo in last month's issue. The transparent Perspex shield over the bank of filter capacitors is a worthwhile safety measure in view of the high supply voltage – 160V in total.

Now unsolder the 390Ω 5W resistors across the fuses, F1 & F2, and fit the fuses. These should be 5A for an 8Ω load and 7.5A for a 4Ω load.

Do not make the mistake of leaving the 390Ω resistors on the board. If the amplifier does blow the fuses at some stage, the resistors will be back in circuit and may contribute to further damage in the amplifier, before they themselves burn out.

You are now ready for a listening test. Connect a loudspeaker and program source and prepare to be impressed.

Finally, a few omissions and errors crept into the parts list published for the amplifier module, on page 32 of the August 1997 issue. Two 300Ω 0.25W resistors were omitted, a 6.8kΩ 1W resistor was specified instead of 8.2kΩ 1W and only five 0.1µF MKT polyester capacitors were specified while 11 are required. Also, the 100pF 500V ceramic capacitor should be an NPO type, Philips 2222 650 10101.

Note that on the PC board component overlay diagram on page 57 of the September 1997 issue, the unlabelled transistor adjacent to trimpot VR1 is Q3, a BC556. **SC**

RADIO CONTROL

BY BOB YOUNG

The philosophy of R/C transmitter programming; Pt.2

This month, we will look at some of the broader issues governing the design and programming of computer transmitters.

This is a fine example of a modern computer controlled 6-channel R/C transmitter. It has memory to cater for up to four different models and host of programming options.

Last month we covered some of the fundamental aspects in regard to model design and their influence on successful programming. Perhaps I should point out that this series of articles is not intended to be a step-by-step programming guide. There are far too many different brands of transmitters, each using a different programming technique, for that approach to be successful.

Instead, I want to establish the fundamental principles upon which programming is based and show how an understanding of these principles can help simplify the programming process and improve safety.

Transmitter design

As noted last month, modern transmitter design has been driven largely by the requirements of the international class competitor allied with the need for mass production and marketing. The smaller the number of models any one manufacturer can produce to capture the largest market share, the more efficient the operation.

This development has crept up slowly and probably began with Phil Kraft when he introduced his Signature Series. This radio had settings for throw in different directions and dual rates. I recall one of the Australian Kraft factory team crashing on one occasion during an aerobatic contest. He hit the ground inverted at the bottom of an outside loop.

When I questioned him about what caused the crash, he informed me that he had the dual rate switch set to low instead of high and the loop diameter was too great for the height available.

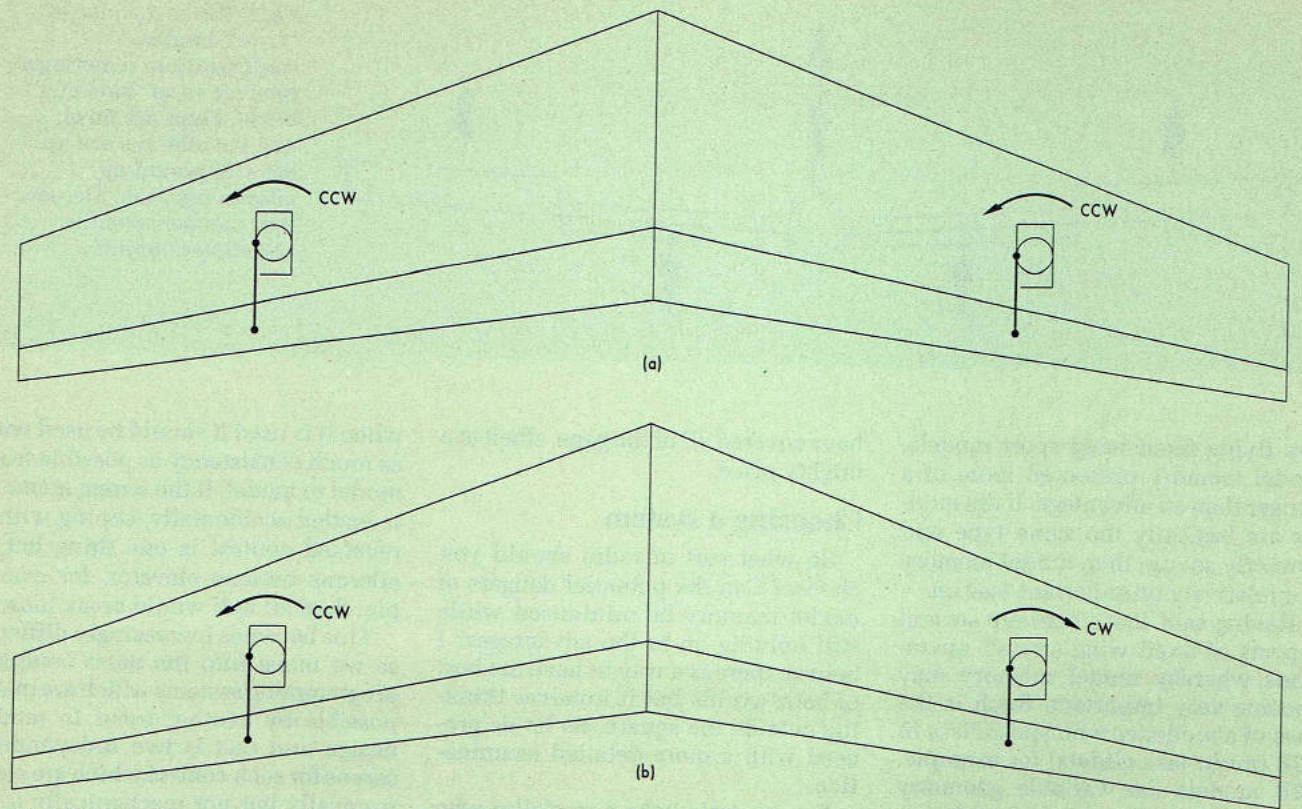


Fig.1: this is the configuration for a "flaperon" wing, showing the direction of servo rotation to achieve (a) flaps or (b) ailerons.

I had been flirting with dual rate at the time and after that I dropped it as I had also found that learning two complete sets of control responses detracted from the purely instinctive response so necessary for high level performance. I am not a great fan of gadgetry for this reason. As a manufacturer I have to play the game and provide these gadgets but personally I like simplicity and prefer to rely on my own physical dexterity.

Soon after, Futaba introduced their "J" series with FM transmission and a few mixers for elevator to flaps and rudder coupling. Both these radios used potentiometer adjustments, no channel allocation and no model memory. Flying a different model meant readjusting the pots if the models were not correctly set up, a situation we dealt with last month. R/C system designers eventually found a better way and that was the computer encoder. Now models of all types could be flown, the sky literally being the limit.

This has lead to the overly complex computer transmitter, designed to be all things to all people, which in many instances has so many features that it just simply overwhelms the beginner and sports flyer.

Basic requirements

Let's look at what a modeller really needs from a transmitter. To begin, it is essential that you have a clear understanding of what your requirements are. At the most fundamental level, this may involve deciding that the transmitter is to be used for cars, boats, aircraft or helicopters. This may involve choosing the ideal physical layout such as wheel or stick transmitter, or the ideal program configuration such as the helicopter specific transmitters now available.

This may seem pretty obvious but what is not so obvious is the next step. That is to decide what is the best system for your branch of the hobby. Fixed wing flyers, for example, fall into broad categories such as beginner, sport, glider, scale, aerobatic, pylon, ducted fan, etc and each category places different demands on the R/C system.

Sport flyers have the minimum requirements in regard to auxiliary features. Scale may call for a relatively large number of channels with few mixing features. F3B gliders place the most stringent demands on the R/C system in regards to complexity of programming.

It is in trying to produce a radio that will cover all of these requirements that has lead the R/C manufacturers to produce the very complex transmitters we now see in the model shops and the computer makes it all possible.

Manufacturers claim that the key to this flexibility is model memory. Some transmitters now offer up to one hundred model memories, a mind bending figure. In view of the fact that many modellers have taken off with the wrong program loaded, such a large number of memories certainly ups the odds in this area.

Last month, we looked at model memory and decided that for model-

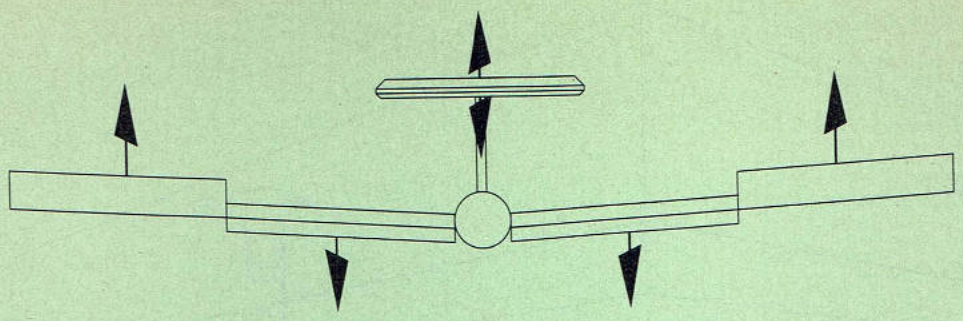


Fig.2: this is a glider in "crow" landing configuration, sometimes referred to as "butterfly" mode. Flaps are down and the ailerons are up but still providing aileron function. Elevator trim compensation is sometimes applied.

lers flying fixed wing sport models, model memory presented more of a danger than an advantage. If the models are basically the same type and correctly set up, then model memory is a relatively unimportant feature.

Having said that, there are several aspects of fixed wing aircraft operations whereby model memory may become very important. Such is the case of a modeller who specialises in F3B (multi-task gliders) for example. F3B models use variable geometry with each configuration stored in a separate model memory. These memories are switched in flight so that with the flick of a single switch, the entire aircraft geometry may be reconfigured. One F3B model may use as many as six or seven memories.

Under these circumstances one hundred memories suddenly shrinks to about fifteen models.

However, here we are talking about the most specialised, highest level competition flying that exists in this sport. The average club flyer has no need for anything remotely like the sort of R/C system called for in F3B. Futaba, for example, in their Super 7 transmitters originally had all three model types, powered fixed-wing aircraft, helicopters and sailplanes, however the sailplane features were lacking. They then released (1993) a sailplane specific system, the 7UGFS, which had to relinquish the helicopter features to make way for the complicated F3B programming.

So the crux of the matter comes back to choosing the correct system for your needs, remembering not to get too ambitious with your first radio.

Since 1993, computers and memory chips have made enormous strides and the very latest transmitters on offer have covered all of the gaps, albeit at a mighty price.

Choosing a system

So what sort of radio should you choose? Can the potential dangers of model memory be minimised while still holding on to the advantages? I believe there is a way to have the best of both worlds but it involves thinking outside the square. So let us proceed with a more detailed examination.

For example, take a modeller who regularly flies sport, aerobatic (F3A) and glider (F3B) models. This would be most unusual modeller I might add, for most modellers specialise in only one or two branches as a rule. For this particular examination we will use the programming manual for the Futaba Super 7 system (7UAPS and 7UAFS), as written in good English by Don Edberg and published by Dynamic Modelling, Irvine CA.

This is as excellent publication which not only gives the programming steps but also the aerodynamic theory behind why such steps are necessary. There are other manuals rewritten for other systems and if they are not available in your area, then as a last resort you should fall back to the factory manual. Unless that is, you have an American system such as the Ace Radio Micropro 8000 system which has an excellent factory manual.

Before we start, it is necessary to look at some of the innovations that have crept into modern transmitters. First is channel allocation, which is the ability to assign each front panel control to a particular channel number in the data transmission sequence. This is a very useful feature but should be used with the greatest of care. Not all transmitters have this function but when it is used it should be used with as much consistency as possible from model to model. If the wrong memory is loaded accidentally, coping with a reversed control is one thing but if ailerons became elevator, for example, then all hell would break loose.

This becomes increasingly difficult as we move into the more complex programming systems which are made possible by another trend in model design and that is two independent servos for each control which are electronically but not mechanically coupled – see Fig.1.

This trend has been accelerated by the increasing size of models, the need for some degree of fail-safe servos on these very large models, the falling cost of servos and finally the ability to mix two different functions into one control. The more obvious configurations such as elevons and V-tail have always called for two servos with mixing on each servo.

However, such configurations as the airbraking system designated CROW (both ailerons UP and flaps DOWN), ailerons mixed into flaps, and the ultra weird "ailevator" configuration where ailerons are mixed into elevators on a standard fixed wing model, all demand two independent servos for their functioning.

So the very first thing we notice in the Futaba manual is the attempted consistency applied to channel allocation throughout the programming descriptions. In the first instance, the channel allocation given in the Super 7 manual for setting up a sports model is ch1 – aileron; ch2 – elevator; ch3 – throttle; and ch4 - rudder. This is the traditional Futaba channel allocation which is still used on their non-programmable transmitters.

The F3A model will follow similar

lines with perhaps ch5 allocated to retracts and ch6 allocated to flaps, if these are used. There would be no problem running these two types of models from the one 6-channel transmitter without model memory, using the techniques discussed last month.

However, when we change to F3B mode the problems begin. Channel allocation suddenly becomes a very different matter. In the F3B model we are dealing with the multi-servo wing as a mandatory item.

The F3B model

The F3B model is a multi-task model which calls for a very high level of aerodynamic sophistication. Variable camber wings are a must for this type of model in order that the launch, speed, cruise, endurance and landing tasks are all carried out in the most efficient aerodynamic configuration.

Thus, the ailerons and flaps are called upon to perform multiple roles, with the ailerons performing the functions of flaps, ailerons or speed brakes in the one flight, often with any two simultaneously engaged. Flaps likewise may be called upon to perform as flaps, reflexed trailing edges to increase speed or even ailerons in some models. In the CROW (landing) configuration, the ailerons are both moved UP to provide airbrakes (whilst still performing as ailerons) and the flaps are at maximum droop.

Elevator trim is mixed in to compensate for the trim shift caused by the flaps and ailerons and coupled aileron/rudder may be engaged to compensate for the loss of aileron efficiency in the UP position – see Fig.2.

To add to the programming confusion, glider wings may be two, three or four servo types, depending on the complexity of the design. Added to this are additional problems of complex mixing of elevators with flaps, flaps with elevators and rudder with ailerons. The F3B glider is the most complex program of all model types and I believe the prime driving force shaping development of the modern computer transmitter.

Yet when I had completed the F3B module for the Mk.22 TX and I needed to run the final testing, I looked around for someone with a four servo wing and could not find one in an easily accessible location. The best I could find at short notice was a two-servo wing. In all of Sydney there is not a handful of these complex models yet they dominate transmitter development the world over. As I stated previously, in trying to cater for the handful, the transmitter designers have made life really tedious for the average flyer.

The channel allocation for the F3B model called for in the Futaba UAFS/PS system is ch1 – right aileron, connected to the aileron stick; ch7 – left aileron, not connected to any front panel control but slaved through an inverting mixer from ch1 to provide the equal and opposite drive signal. Ch3 is right flap and ch6 is left flap, both connected in parallel with ch3 connected to the throttle stick to provide flaps. Ch2 is elevator and ch4 is rudder. Ch5 is left unused.

From the above it would appear at first glance that there is no possibility of flying sport and F3A models from this transmitter configuration without model memory, which is oddly enough quite wrong. We still have a throttle stick, aileron stick, elevator stick and rudder stick all in the correct locations.

So long as all models are fitted with seven channel receivers and absolute consistency is adhered to in regard to channel allocation and servo directions, there is still no danger of model memory causing a catastrophic result if the wrong memory is accidentally loaded.

Even if the sport program is loaded for the F3B model, at least one half of each control will work in the correct sense and direction, although one half of the flaps working would certainly raise the adrenalin levels for a while. However, problems could arise if the channel allocation was changed to squeeze in a 6-channel receiver in one or more models in your fleet. So as a general rule, the larger the number of channels available in your system the easier and safer programming becomes.

One final point: many manufacturers make a big deal about their trim memory function. This function stores the trim offsets for each model. Here is one function that you could well do without. Make sure that all servos are correctly neutralised and that all trims are in neutral for all models, when the final trimming of each model is complete. That is the only approach if you want to avoid a nasty surprise one day. SC

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April 1997: Avoiding Windows 95 Hassles With Motherboard Upgrades; Simple Timer With No ICs; Digital Voltmeter For Cars; Loudspeaker Protector For Stereo Amplifiers; Model Train Controller; Installing A PC-Compatible Floppy Drive In An Amiga 500; A Look At Signal Tracing; Pt.1; Cathode Ray Oscilloscopes, Pt.8.

May 1997: Windows 95 – The Hardware Required; Teletext Decoder For PCs; Build An NTSC-PAL Converter; Neon Tube Modulator For Light Systems; Traffic Lights For A Model Intersection; The Spacewriter – It Writes Messages In Thin Air; A Look At Signal Tracing; Pt.2; Cathode Ray Oscilloscopes, Pt.9.

June 1997: Tuning Up Your Hard Disc Drive; PC-Controlled Thermometer/Thermostat; Colour TV Pattern Generator, Pt.1; Build An Audio/RF Signal Tracer; High-Current Speed Controller For 12V/24V Motors; Manual Control Circuit For A Stepper Motor; Fail-Safe Module For The Throttle Servo; Cathode Ray Oscilloscopes, Pt.10.

July 1997: Infrared Remote Volume Control; A Flexible Interface Card For PCs; Points Controller For Model Railways; Simple Square/Triangle Waveform Generator; Colour TV Pattern Generator, Pt.2; An In-Line Mixer For Radio Control Receivers; How Holden's Electronic Control Unit works, Pt.1.

August 1997: The Bass Barrel Subwoofer; 500 Watt Audio Power Amplifier Module; A TENs Unit For Pain Relief; Addressable PC Card For Stepper Motor Control; Remote Controlled Gates For Your Home; How Holden's Electronic Control Unit Works, Pt.2.

September 1997: Multi-Spark Capacitor Discharge Ignition; Build The 500W Audio Power Amplifier, Pt.2; A Video Security System For Your Home; PC Card For Controlling Two Stepper Motors; HiFi On A Budget; Win95, MSDOS.SYS & The Registry.

PLEASE NOTE: November 1987 to August 1988, October 1988 to March 1989, June 1989, August 1989, May 1990, August 1991, February 1992, July 1992, September 1992, November 1992 and December 1992 are now sold out. All other issues are presently in stock. For readers wanting articles from sold-out issues, we can supply photostat copies (or tear sheets) at $7.00 per article (includes p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge. A complete index to all articles published to date is available on floppy disc for $10 including p&p.

PRODUCT SHOWCASE

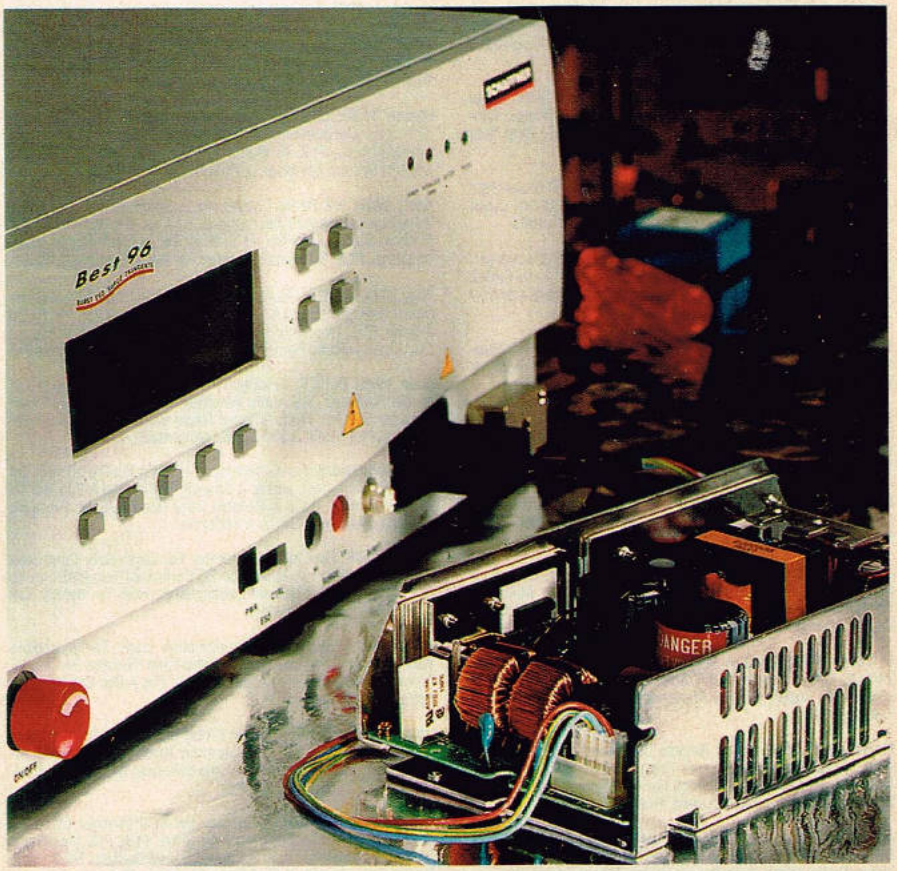
Electromagnetic compatibility test system

The Schaffner BEST 96 EMC test system combines all necessary functions for full compliance testing of residential, commercial and light industrial electrical and electronic products.

The BEST 96 system comprises a multi-function generator providing burst, electromagnetic discharge (ESD), surge and power quality pulses (for single-phase power line and data line compliance), a ground plane, cables, ground strap, grounding resistor and coupling clamp for data line testing and a step-by-step instruction manual.

BEST 96 provides a universal interface/coupler into which the product-under-test is plugged in and preprogrammed tests using "built-in" test pulses are then run. The testing procedure has all signal functions controlled from the BEST 96 front panel or alternatively, from a PC using Windows-based software.

For further information, contact Westek Industrial Products Pty Ltd, Unit 2, 6-10 Maria St, Laverton North, Victoria 3026. Phone (03)9369 8802 or Fax, (03)9369 8006.



1GHz RF spectrum analyser

The new Laplace SA1000 1GHz Spectrum Analyser is controllable by any PC capable of running under Windows and is suitable for in-house EMC testing. Frequency coverage is from 20kHz to 1.1GHz with selectable start and stop frequencies and logarithmic or linear scaling. The single frequency mode of the instrument permits true averaging and quasi-peak measurements which can be plotted against time to enable the monitoring of trends and excursions as required by EMC standards for fluctuating emissions.

The software package (EMC Engineer) also provides other important capabilities including antenna factor compensation; background nulling; multiple trace comparison; and limit line display for common EMC standards.

The SA1000 has very high sensitivity to low field strengths down to less then 17dBμV/m (when used with the Laplace broadband antenna). An inbuilt calibration source confirms the operation and accuracy of the analyser. An audio modulator and internal loudspeaker are also provided. The demodulation technique is suitable for both FM and AM signals.

For further information, contact Nilsen Technologies, 150 Oxford St, Collingwood, Vic 3066. Phone (03) 9419 9999; fax (02) 9419 1312.

Westcode power semiconductors

A broad range of Westcode Semiconductors (UK) Ltd's devices is now available in Australia. They include thyristors, distributed gate (fast turn off) thyristors, high frequency thyristors, diodes and fast recovery diodes.

These devices can be supplied, mounted within insulated base modules such as the WK250 series and are available in double thyristor, thyristor/diode, diode/thyristor and double diode arrangements. Westcode semiconductor assemblies feature a choice of integral water-cooled and air-cooled packages.

The compression mounting technology in conjunction with ceramic device packaging ensures excellent hermeticity and heat conduction properties while maintaining high electrical isolation (withstanding voltage of 2.5kV RMS). Devices available have peak reverse voltage ratings ranging from 500V to 1700V at a junction operating temperature of 130°C.

Air-cooled devices can operate at typically 300A (thyristors) and 250A (diodes) as measured on half-cycle sinewave average basis and at an ambient temperature of 85°C. Water-cooled devices (eg, an AC diode switch) can operate at 750A RMS (inlet water at 25°C and flow rate of 4.5

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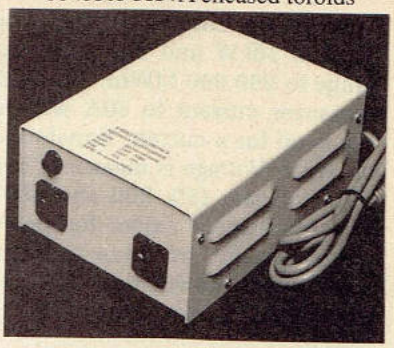

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Value for Money 60MHz & 100MHz Scopes

Tektronix' new TDS-200 Series scopes are affordable, compact, general purpose digital storage scopes that offer more additional facilities than any analog scope.

The technological breakthrough that these new scopes offer is an extraordinarily high **1GS/s real-time digitising rate** plus a very rapid screen update rate, resulting in a digital scope with display response of an analog scope, at an analog scope price.

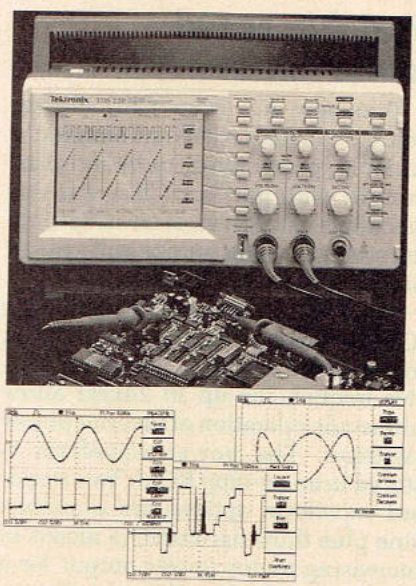
The TDS-200's are specifically designed to make general purpose waveform measurement, TV and video signal work much quicker, more reliable and versatile.

Screen displays can easily be down loaded to a PC using the TDS-200's optional serial/parallel/GP-IB interface, the **TDS2CM**.

2 models are available:
TDS210: 60MHz at $1395 ex-tax &
TDS220: 100MHz at $1995 ex-tax

TDS-200 Series Features -
- **2 Channels** plus viewable Ext. Trigger
- **1GS/s** Real-time sampling/channel
- **Full Dual Timebase** with zoom
- **Auto Setup:** one button autoranging
- **Cursor Measurements**
- **Automatic Measurements**:Frequency - Period - Cycle RMS - Mean - Pk-to-Pk
- **Reference Waveform Memories**
- **Display Modes**: Dots - Line - Persistence
- **Bright, Fast Response, LCD Display**
- **Variable Hold-off**
- **Optional Interface:** RS-232, Parallel & GP-IB.

TDS210 $1,395 ex-tax $1,702 Incl. Tax



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- **PERTH** Ph: 361-4200 Fax: 361-4300

Hioki single-phase power meter

The new Hioki Model 3330 Power meter covers the range from 30W to 18kW and has an energy range to 999,999 MWhr. The 3330 measures current to 30A without the need for a current transformer or shunt. Voltage is measured over three ranges: 150, 300 and 600V. The instrument caters for power measurement on inverters and switchmode power supplies, having a bandwidth from 10Hz to 50kHz.

The unit also measures frequency up to 50kHz. An inbuilt comparator function permits adaptation to assembly line operations and automatic testing (ATE) together with optional RS232 and GPIB interfaces. Basic accuracy is ±0.3% and fast response time is 0.4 seconds, making the instrument suitable for transient measurements.

For further information contact Nilsen Technologies, 150 Oxford Street, Collingwood, Vic, 3066. Phone (03) 9419 9999; fax (03) 9416 1312.

litres/min) compared to an air-cooled equivalent of 555A RMS at an ambient temperature of 85°C.

For further information, contact Westek Industrial Products Pty Ltd, Unit 2, 6-10 Maria St, Laverton North, Vic 3026. Phone (03) 9369 8802; fax (03) 9369 8006.

Variable speed motor control ICs

Two new ICs from GEC Plessey Semiconductors (GPS) are targeted at variable speed motor control applications in white goods, such as washing machines, fan drives in air conditioning systems, water pumps and general purpose industrial inverters.

The SA828 3-phase PWM generator IC is designed for use in AC induction motor drive systems. Switching carrier frequencies up to 24kHz allow ultrasonic operation of inverter power switches. The power waveform is stored in an on-chip ROM. Two standard waveform options are available: sine plus third harmonic (a means of increasing motor power output for a given line supply voltage to the inverter) or pure sine. Other waveforms can be provided to customer order.

The SA828 operates as a standalone microprocessor peripheral imposing just a small processing overhead on the microprocessor as it requires attention only if the frequency or amplitude of the output waveform needs to be changed. Any of the popular 4 or 8-bit microprocessor and microcontrollers can be interfaced with the SA828.

The SA838 is a single phase variant and is available for applications such as uninterruptible power supplies or single phase induction motor drives.

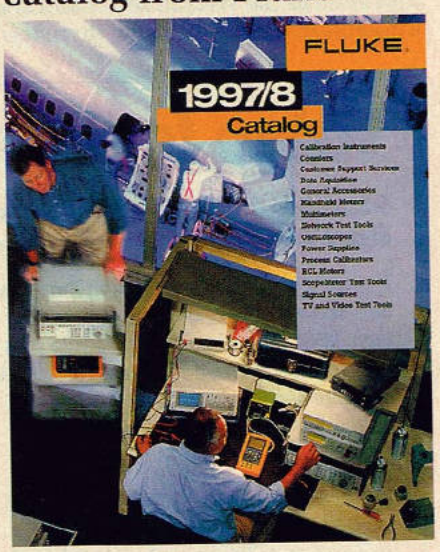
For further information, contact GEC Electronics Division, Unit 1, 38 South St, Rydalmere NSW 2116. Phone (02) 9638 1888.

Charger conditioner for nicads

Premier Batteries has introduced a single module charger conditioner which uses negative pulse technology to charge and condition nickel cadmium and nickel metal hydride batteries. The charger is supplied with dedicated cup modules to cater for Motorola Saber, Visar, MTS2000, HT600, GP300 and the Bendix King Radio. It has the added advantage of a 12V charger for in-car use.

It will charge batteries in approximately one hour and the negative pulse conditioning will maintain the peak charge indefinitely, without shortening battery life. For further information, contact Premier Batteries Pty Ltd, 9/15 Childs Road, Chipping Norton, NSW 2170. Phone (02) 9755 1845.

New instrumentation catalog from Fluke



Philips Test & Measurement has released the 1997/98 Fluke instrumentation catalog. The 242-page catalog describes the complete range of more than 400 Fluke products including selection guides, accessories and customer support information. It features 19 sections for product categories such as Scopemeters, multimeters, bench oscilloscopes, timer/counters, generators and network test tools.

The catalog is available from Philips Test & Measurement. Phone (02) 9888 0416; fax (02) 9888 0440. SC

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AMD K6-233	$1780	$1990
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IBM MMX 200	$1775	$1975
Pentium™ 166 MMX	$1645	$1845
Pentium™ 200 MMX	$1795	$1995
Pentium™ 233 MMX	$2095	$2395
Pentium™ Pro 200	$2250	$2590
Pentium™ II 233	$2450	$2720
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8M 72 pin EDO	*$53*	*$51*
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16M 72 pin EDO	*$95*	*$89*
32M 72 pin	$195	$189
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AMD K6 166 with TX MB	$495		
AMD K6 200 with TX MB	$545		
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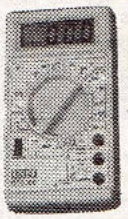

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DC current:	200A/2000A/20mA/200mA/10A
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SPECIFICATIONS:	
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Basic accuracy:	+/-0.5%
Input Impedance:	1M
Maximum output:	1000V DC
AC Voltage:	200/750V
DC current:	200A/2000A/20mA/200mA/10A
Resistance:	200Ω/2000Ω/20kΩ/200kΩ/2M
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Antenna impedance: 75ohm
Ceramic filters for high sensitvity of FM stations. Auto Scan/Manual Scan & Fine Tuning

COMPONENT TRAY

A92078 **$9.95**

Keep all your electronics components neatly in these component tray. Makes it easy to find what you need! 275 x 425mm

Vvvvroom... The Ultimate Race Game Driving Experience

PER4MER™ FORCE FEEDBACK WHEEL

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- *Arcade-style control*
- *Includes four suction cup feet*
- *50 degree rotation*
- *Self-centering "pivoting" mechanism*
- *Direct game port connection*
- *Durable injection moulded construction*
- *1 year warranty*
- *Designed & engineered in U.S.A.*

Includes Racing Pedals

C14299 **$169.95**

Multimedia Headset with Boom Microphone

Great for:

- Voice dictation
- Voice-fax modems
- Listening to music
- Internet Phone
- Recording
- Voice activation
- Game play

A14023 ONLY **$19.95**

SPEAKER:
27mm High Efficient Mylar Speaker x 2
Max. Power Input 50mW
3.5mm Stereo Nickel Plated Plug
Input Impedance-32ohms
Frequency Resp- 100Hz- 10KHz
MICROPHONE:
Omni-Directional Mic. Capsule
Sensitivity 60db +/ -3dB
3.5mm Stereo Nickel Plated Plug

40 PIECES TOOL KIT

40 pieces Tool Kit with ratchet driver, adaptor and multiple bits. All packed in a plastic carry case. • 1 Reversible Ratchet Driver • ¼ Drive Adaptor • 4 Magnetic Nut Setter • 3 Slotted Bits- 5/ 6/ 7mm • 3 Philips Bits- #1, #2, #3 • 2 Robertson Bits- #1, #2 • 8 Hex Bits- 1.5/ 2/ 2.5/ 3/ 4/ 5/ 6 & 6.5mm • 7 Star Bits- T10, T15, T20, T25, T27, T30, T40. • 7 ¼ Nut Driver Socket AF 3/16, ¼, 5/16, 11/32, 3/8, 7/16, ½. • 7 ½ Nut Driver Socket MET 6/ 7/ 8/ 9/ 10/ 11/ 12mm

T12201

KEEP ONE HANDY IN YOUR TOOL BOX!

REUSE 30 PIN SIMM RAM!

4 X 30 PIN TO 72 PIN ADAPTOR

Don't throw away your old 30 pin SIMM RAM - Reuse them in new 486DX4 motherboards with this innovative adaptor.

AVAILABLE IN LEFT OR RIGHT FACING MODULE

ONLY **$11.95**

RECYCLED 3.5" HD DISKS

A unique Australian product. These recycled diskettes are acquired from a large software company and have contained only proprietary software. The disks are unformatted, then fully tested and reformatted providing a very high grade, ready to use diskette. Kali is an aboriginal word for "boomerang" taken from the Aboriginal Kukatja dialect.

UNBELIEVEABLE VALUE!

1-9	10-99	100+	1000+
$3.95	$3.75	$3.50	$3.00

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From the makers of AMIBIOS® -the first program with specific test for: • PCI • PnP • EISA • Pentium™ Packed with diagnostic features that test CPUs, video modes/memory, motherboard functionality, COM ports, Sound Card, Speaker, Hard Disk, Floppy Disk Drive and Keyboard & Mouse. Power management setup display and much more! ***Requires AT 286, 386, 486, Pentium or higher processor.*** ***FREE LOOP BACK PLUGS.***

89123 **$169**

HIGH PERFORMANCE IBM JOYSTICK

FEATURES **CHEAP!**

- X & Y axis trim adjusters
- High speed turbo function (option)
- High performance IBM Analog joystick • Turbo & manual switch
- High impact robust body
- Ultra-sensitive, but durable fire buttons • Highly accurate control capability
- Ergonomic designs
- Auto-centering
- 4 stabilizing suction cups
- Cord length: 5ft

C14223 **$17.95**

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400 watts
P.M.P.O. OF THUMPING POWER
with these 3 piece Stereo speaker set

C10246
$109
YOUR COMPUTER GAMES WILL REALLY ROCK THE HOUSE!

Dimensions:
SPEAKERS- 100W x 95D x 195H mm
WOOFER- 140W x 215D x 250H mm

HANDY TECHNICIANS "SNAKE LIGHT" TORCH

IDEAL FOR PCB BOARD REPAIRS OR ANY OTHER ELECTRICAL EQUIPMENT WORK

A15090
$29.95

Ultra thin flexi light. The flexible gooseneck can be adjusted to almost any angle. Ideal for technicians, hobbyists etc. •Simple pen click motion to turn the light on or off •Handy and convenient size for easy use •Minature light bulb simply screws out for replacement •Requires two AAA batteries •Spare bulbs available •Length 405mm

CORD UNTANGLER

PREVENT FRUSTRATING TANGLES

Finally this long awaited product has arrived. It keeps your telephone cords untangled! It achieve this by rotating the cord as you use the handset thereby eliminating that annoying tangle you get with telephone cords.

- RJ11 plug to sockets
- High tech swivel system
- Easy inline installation

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$9.95

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IDEAL FOR AEROBICS INSTRUCTORS, COMPUTER OPERATORS, ETC.

A12122
$39.95

Ultra light-weight headband microphone with anline power supply which connects directly into standard microphone input. Suits users such as aerobics instructors, computer operators, etc.

SPECIFICATIONS:

•Impedance:	Low
•Freq. resp:	50Hz to 15Khz
•Sensitivity:	-65dB+/-3dB
•Cable:	1.6m@ 2.5mm Ø
•Height:	36cm
•PSU:	3.5mm mono Socket to 6.2mm plug

DESK TOP PAGING MICROPHONE

IDEAL FOR HANDFREE OFFICE INTERCOM PAGING SYSTEM

$99.00

Flexible gooseneck unidirectional microphone ideal for use in PA installations.

- Sturdy construction •Lockable talk switch
- Switching contacts for priority paging

SPECIFICATIONS:

•Impedance:	600Ω
•Freq. resp:	100Hz to 10Khz
•Sensitivity:	-74dB. 0.4mV @94dB SPL
•Switching:	300mA low voltage
•Height:	36cm
•Cord:	2.0m curly supplied

•110W x 363H x 150D mm

Note: Requires either a 6.35mm jack or XLR plug

THIS PRODUCT WILL HAVE YOU A'BUZZ WITH EXCITEMENT!

ITS THE BLANK CD-ROM DISKS ON A BEEHIVE

50 BLANK CD-ROM DISKS VALUED AT $4.50 EACH

C11963
$245

UNBEATABLE VALUE!

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Telephone ringer and flasher unit which connects directly into your phone and is positioned somewhere away from the phone. The flashing light helps people with hearing impairments to see the phone being activated and the buzzer just reinforces the ringing sound made by the telephone already.

Y15112
$21.95

- Selector switch for either flasher or ringer
- 60cm line cord with RJ12 connector
- White colour

RJ45 TO RJ12 ADAPTOR CORD

Y16120
$4.95

Adaptor cord wired in reverse form to adptor from an RJ45 phone wall outlet to and RJ12 socket telephone

• 6 pins wired each end •50p gold plated contacts on each connector • Length: 20cm

PIEZO SIREN

D-I-Y SECURITY FOR PROTECTING YOUR HOME, OFFICE, ETC!

- Very small and easy to install
- High impact plastic (white)
- Input 12V DC - 150mA
- Output 110dB at 1 metre, dual tone.

S15069
$14.95

REMOVABLE-2.5" & 3.5" H.D.D. FRAME

$69.95

C11933

This frame suits 2.5" or 3.5" hard disk drives format and will fit into any computer casing from Tower to Desktop models. Great for exchanging data with other system or expanding your system capability to work with more data without the need for lengthy hdd installation. Simply connect another hard drive to this carrier.

MULTIMEDIA AMPLIFIED COMPUTER SPEAKER

$29.95

20 WATT P.M.P.O.

Magnetically shielded speakers for monitor, drive and disc protection

•Power output:	20 watt P.M.P.O.
•Speaker Impedance:	4Ω
•Freq. resp:	20 to 20K Hz
•Dimensions:	150H x 95W x 95D mm

Volume with ON/OFF control
Bass/Treble control

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DC 12V. For 486 CPUs.

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$8.00	$6.50	$5.25

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For Pentium/ 686 CPUs. With metallic clipfor Zif socket 5 or 7

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To suit Photographic Timer for Darkrooms (SC April 95)

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IR-2155 SELF-OSCILLATING HALF-BRIDGE MOSFET DRIVER

U10650 ..... **$10.45**

IRF-610 200V 1A N-CHANNEL TO-220 MOSFET

U10815 ..... **$2.45**

*TO SUIT **K10875** .. TRANSCUTANEOUS ELECTRICAL STIMULATION SC AUG'97*

IC SPECIALS

OLD STOCK. WE HAVE TOO MANY, SO OUT THEY GO AT RIDICULOUS PRICES

Cat No.	NORMALLY	1-9	10-99
U21990 - 81LS95	$2.75	50¢	40¢
U10600 - LM301N OP AMP	$1.00	40¢	30¢
U11820 - NE567 Tone Decoder	$2.00	$1.00	80¢
Z14520 - 4520	$1.50	50¢	40¢
Z17006 - 7406	$1.00	20¢	15¢

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MJE-340 300V 500mA NPN TO-126 TRANSISTOR

T90420 ..... **$2.00**

MJE-350 300V 500mA PNP TO-220 TRANSISTOR

T90421 ..... **$2.00**

MJL-21193 250V 16A 200WATT PNP TOP-3 TRANSISTOR

T90435 ..... **$9.95**

MJL-21194 250V 16A 200WATT NPN TOP-3 TRANSISTOR

T90436 ..... **$9.95**

To suit 500-Watt Audio Amplifier (SC Aug'97)

TDA 1514A

A very high quality audio amplifier in a 9-pin flat package. The amplifier will deliver 40W into a 8Ω load with ±21.5V power rail. With overload protection and is designed to meet the requirements of digital sound sources such as compact disc or car stereos.

1. Non-inverting input (#1)
2. SOAR
3. Mute
4. -vs
5. Output
6. +vs
7. Bootstrap
8. 0V Non-inverting input (#2)
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	1-9	10+
U10183	$12.95	$10.95

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Buy this i n bulk for replacement

- Enhanced 105-key layout
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- Multi-key rollover runction

X12301 1-9 **$21.95** 10+ **$19.95**

2MM LED LAMPS

LEDs subject to change

Cat No.	COLOUR	WAVE LENGTH	LUMINOUS INSTENSITY mcd
Z10185	RED	700	0.5-12.5
Z10186	GREEN	565	3.2-8.0
Z10187	YELLOW	590	3.2-8.0
Z10188	ORANGE	625	12.5-32.0

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FAST RECTIFYING DIODE

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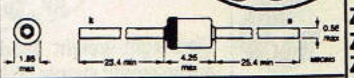

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Half Angle: 16°
Response: 5
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Sensitivity: 4.0 (min) @ 20mW/cm²

LOW COST ANALOG MULTIPLIER AD633

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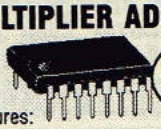

U20030 **$11.95**

Features:

- Four-Quadrant Multiplication
- Low cost 8-pin package
- Complete-no external components required
- Laser-trimmed accuracy and stability
- Total error within 2% of FS
- Differential high impedance X and Y inputs
- Laser-trimmed 10V scaling reference

APPLICATIONS:

- Multiplication, Division, Squaring
- Modulation/ Demodulation, Phase detection
- Voltage-controlled amplifiers. Attenuators/ Filters

The AD633 is a functionally complete, four-quadrant, analog multiplier. It includes impedance, differential X and Y inputs and a high temperature summing input (Z). The low impedance output voltage is a nominal 10V full scale provided by a buried Zener. The AD633 is the first product to offer these features in a modestly priced 8-pin plastic DIP and SOIC packages.

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- Uses **only 1 ink cartridge** for 4 colour: Black, Cyan, Magenta & Yellow.

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High quality output features:

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- 12 months warranty for total peace of mind.

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$246 C92440

$295 TAX INC

4 COLOUR INK CARTRIDGE C92442

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CD-ROMS PACKED WITH EVERYTHING YOU HAVE EVER WANTED TO KNOW ABOUT ELECTRONICS-BUT DIDN'T DARE ASK!

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2.5" & 3.5" REMOVABLE HDD CARRIER

REMOVABLE-2.5" & 3.5" H.D.D. FRAME

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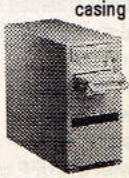

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K10910*	FLICKERING FLAME	$20.75

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VERSATILE LOW VOLTAGE ADAPTOR

This little project is just the shot for those occasions where a low-voltage regulated DC source is needed from a small package. Based on a robust but low-cost regulator IC, the adaptor uses push-on jumper links to preset the output voltage between 3V and 15V, and depending on the heatsink you use, can deliver an output current of up to 1.5 amps. You can use it to power external peripherals from a PC, or to run a personal CD player from a car's cigarette lighter socket. *EA Aug'97*

K10860 $8.45 ALL NEW!

A "NO FRILLS" ACTIVE ANTENNA

Designed purely for use with the popular 49 to 13 metres shortwave bands, and does away with a lot of excessive circuitry. The result is a cheap, low cost antenna that gives good performances using only a short whip antenna

K10895 $23.95 ALL NEW!

FLICKERING FLAME

This little lighting gimmick was used by the dozen at a recent school eisteddfod. It uses a 12V 20W halogen lamp/reflector fitting mounted in a plastic drink bottle filled with red cellophane. A group of these gives a convincing imitation of fire, hence the name "Flickering Flame". SC Sept'97

NO PICTURE AVAILABLE AT TIME OF PUBLICATION

K10915 $20.75 ALL NEW!

PHONE CONTROLLED REMOTE POWER SWITCH

When connected to a modem, this low-cost project will activate its 240V AC outlet when a pre-determined number of rings occur on the phone line. Dubbed the Remote Power-up, it's ideal for communication sessions between PCs where the remote "host" is normally off- a far more secure way to leave an unattended PC and its valuable data. The unit has an automatic or manual shut-off feature, is easy to build common off-the-shelf parts, and can be used for a range of other remote power control tasks. ***Jumper box is included. EA JUN'97***

K10845 $64.95 ALL NEW

Kill pain with TRANSCUTANEOUS ELECTRICAL STIMULATION

Do away with analgesics and alleviate pain electronically with a TENS Unit. This produces pulses of current into electrodes placed on the skin adjacent the painful area and has a success rate on most sufferers. The TENS unit provides the necessary features and is considerably cheaper than commercially available units. *SC Aug'97*

CASE MAY VARY

K10875 $71.95 ALL NEW!

LOW COST SIMPLE WAVEFORM GENERATOR

This compact unit produces both square and triangle waves over the frequency range from 100Hz to 20KHz. Build it and use it to test audio amplifiers, filters, tone decoders and digital circuits. *SC Jul '97*

K10855 $21.25 ALL NEW!

ADDRESSABLE CARD FOR DRIVING ONE STEPPER

This interface card allows you to drive a stepper motor using software control. It plugs into your PC's parallel port and you can connect up to eight units in daisy-chain fashion. *SC Aug'97*

K10880 $40.95 ALL NEW!

5-DIGIT TACHOMETER

A highly flexible tachometer circuit that should cope with virtually any engine or rotating machinery. It has a crystal timebase and a resolution of one rpm.

NO PICTURE AVAILABLE AT TIME OF PUBLICATION

K10900 $106.45 ALL NEW!

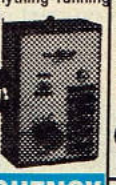
INTERIOR LIGHT DELAY FOR VEHICLES

Fit this project to your car and the courtesy lights will stay on for an extended period after the door is closed, then fade out gracefully. It's small, low in cost, can be installed without cutting any existing wires, and can be configured to suit virtually any cars. *EA APR'87*

K10830 $8.45 ALL NEW!

THE MINISTROBE: USING THE WHITE LED

This little project take advantage of the White LED's bright white light, its high efficiency and fast response time. The Ministrobe can effectively "stop the motion" of almost anything running from 400 to 4000rpm, such as electric motors, car engines, electric mixer. *EA Aug '97*



K10870 $24.45 ALL NEW!

AUDIO FREQUENCY SHIFTER

Here's a new low cost design for a unit which can be of great assistance in controlling feedback ("howl-round") in public address and other sound reinforcement systems. It operates by shifting the audio spectrum by 5Hz, and features a very low noise and distortion over a full 20Hz to 20kHz bandwidth. *EA Aug '97*

SHORT FORM

K10865 $82.45 ALL NEW!

POINT CONTROLLER FOR MODEL RAILWAY

Most model railway enthusiasts operate their points with a twin solenoid connected to a 15V supply. However, if you keep your finger too long on the button for just a moment too long, you can easily burnt out the solenoid coil. This point controller avoids that problem. *SC Jul '97*

K10850 $11.75 ALL NEW!

MANUAL CONTROL CIRCUIT FOR A STEPPER MOTOR

This ciruit will give you manual control of a stepper motor in one direction or the other. It will have a variety of applications and a demonstration is included to show how it could be used to control a model railway boom gate. Motor is not included. *SC JUN'97*

K10840 $23.75 ALL NEW!

TRAFFIC LIGHTS FOR AN INTERSECTION

Most model railway layouts have a few roads winding their way around and often a small town with an intersection is included. A good way to add life to such a scene is to have working traffic lights at the intersection. *SC MAY'97*

K10835 $18.95 ALL NEW!

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VINTAGE RADIO

By JOHN HILL

Wave-traps: another look

A versatile wave-trap can be a useful accessory in any area where there is a strong local station. A wave-trap can make a big difference when it comes to tuning other stations and all my vintage receivers, superhets included, perform better when used with a wave-trap.

As the crow flies, 3CV Central Victoria on 1071kHz is about six kilometres from where I live. Its 5kW output belts out 24 hours a day and to a vintage radio enthusiast such as myself, my local station is a complete pain in the neck – so to speak!

When it comes to crystal sets, simple regeneratives and TRF receivers, 3CV dominates the dial. When listening to a simple crystal set, the local station can be heard over the full tuning range. TRF receivers handle the situation a little better but the amount of interference can still be very annoying.

Even superhets with their superior selectivity are not immune to the problem and splatter from 3CV can be heard some distance either side of the 1071kHz position on the dial.

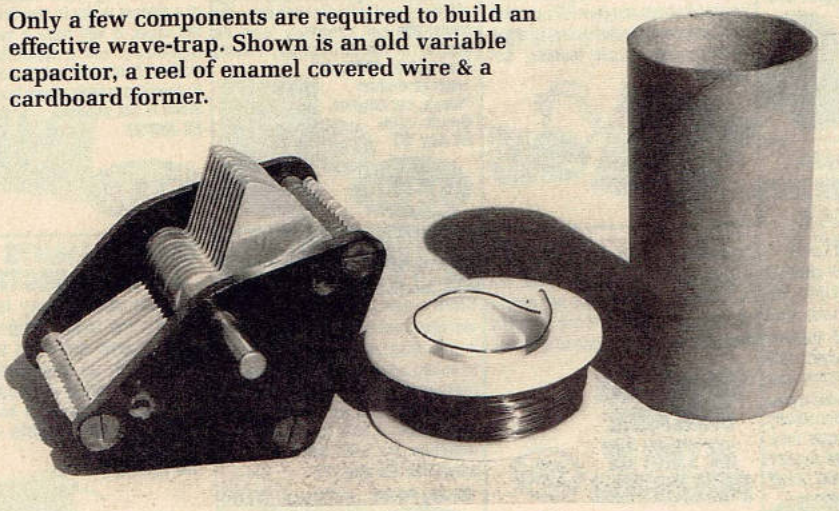
My local radio station has not always caused such frustration. Some years ago, 3CV ceased transmission at 11pm every night, thus providing a good opportunity to listen beyond the usual veil of interference.

Using a simple crystal set, I was amazed to find other stations out there just waiting to be heard. These included 3BO Bendigo, 3BA Ballarat, 3LO Melbourne, and even 5AN Adelaide on odd good nights. However, those exciting late-night long distance DX sessions with crystal sets came to an abrupt end when 3CV changed to 24-hour nonstop broadcasting.

It was much the same when I was a lad living in Bendigo. Back then, 3BO swamped my crystal sets and little regenerative receivers. So local radio stations have been an annoyance to me for most of my life.

It is not surprising, therefore, that I have spent some time experimenting with wave-traps. The basic function of such a device is to block out any unwanted frequency (the strong local) yet, at the same time, let all the other frequencies through. It sounds good but there are trade-offs as you will see later on.

Only a few components are required to build an effective wave-trap. Shown is an old variable capacitor, a reel of enamel covered wire & a cardboard former.



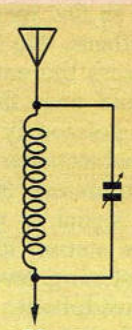
Different designs

Wave-traps (or rejector circuits as they are correctly termed) are nothing new and many old wireless magazines published details on how to build them. I have tried several different types over the years and have found that they all have advantages and disadvantages. Finally, I have come up with a fairly good compromise.

There are quite a few different designs of wave-trap but three in particular are applicable to vintage radio receivers. The first one to be discussed is the common parallel tuned trap (Fig.1).

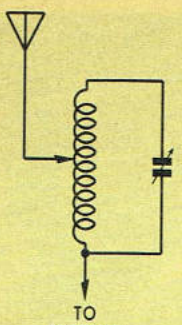
As can be seen from Fig.1, this type of trap is connected in series with the aerial lead. When tuned to resonance with the strong local station, it blocks (or rejects) that frequency while allowing other frequencies to pass through it (apart from those close to the resonant signal).

This type of wave-trap works very well on superhet receivers and the



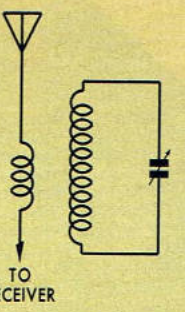
PARALLEL TUNED
WAVE-TRAP

Fig.1: the parallel tuned wave-trap is easy to build. It uses just a coil and a variable capacitor.



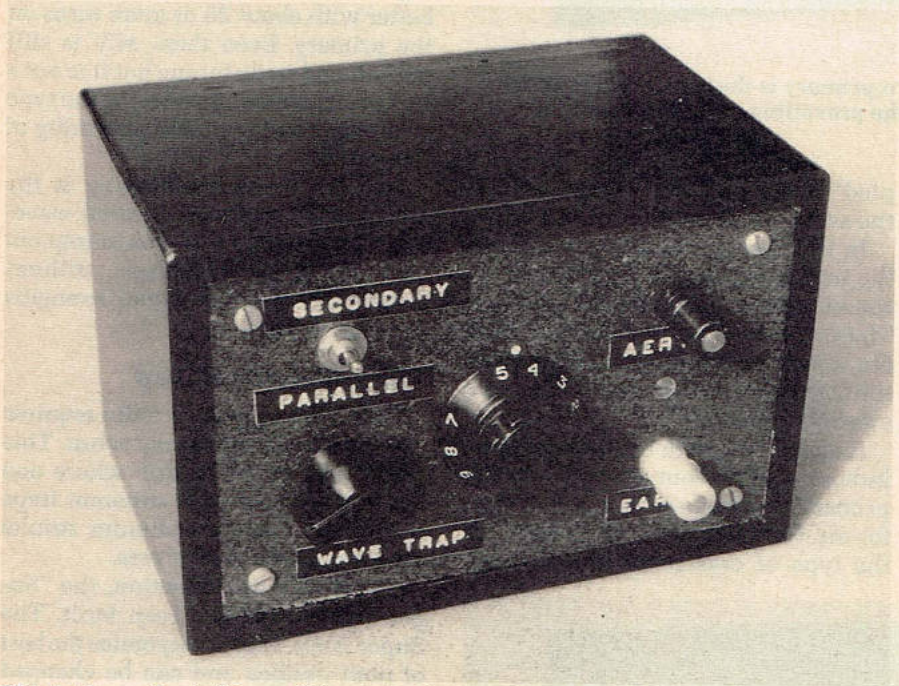
TAPPED PARALLEL TUNED
WAVE-TRAP

Fig.2: by connecting the aerial to different points on the coil, the effectiveness of the trap can be varied.



TUNED SECONDARY
WAVE-TRAP

Fig.3: the tuned secondary wave-trap works well with crystal sets and simple regenerative receivers.



This is the author's "Super Wave-Trap". It can be changed from a parallel-tuned configuration to a secondary-tuned configuration at the flick of a switch. What's more, in secondary-tuned mode, the aerial can be switched to any of the four taps on the primary winding.

previously mentioned splatter either side of 3CV is reduced to nothing. But this benefit is not without a small cost.

Other nearby stations are reduced in volume a little as a result of using the trap and there is also some degree of attenuation over the rest of the dial. So what the trap giveth with one hand, it taketh away with the other.

But any good 5-valver can make up for any losses the parallel-tuned, series-connected wave-trap may introduce. Lesser receivers are not so tolerant, namely crystal sets and small regenerative receivers.

The effect of a parallel-tuned trap on a crystal set is interesting. However, before going into details, mention should be made of another powerful local station.

Some 145km away at Horsham, the 50kW transmitter used by 3WV on 594kHz is powerful enough to be considered a strong local station. In crystal set terms, it supplies quite good listening volume and is the second most powerful station in my listening area.

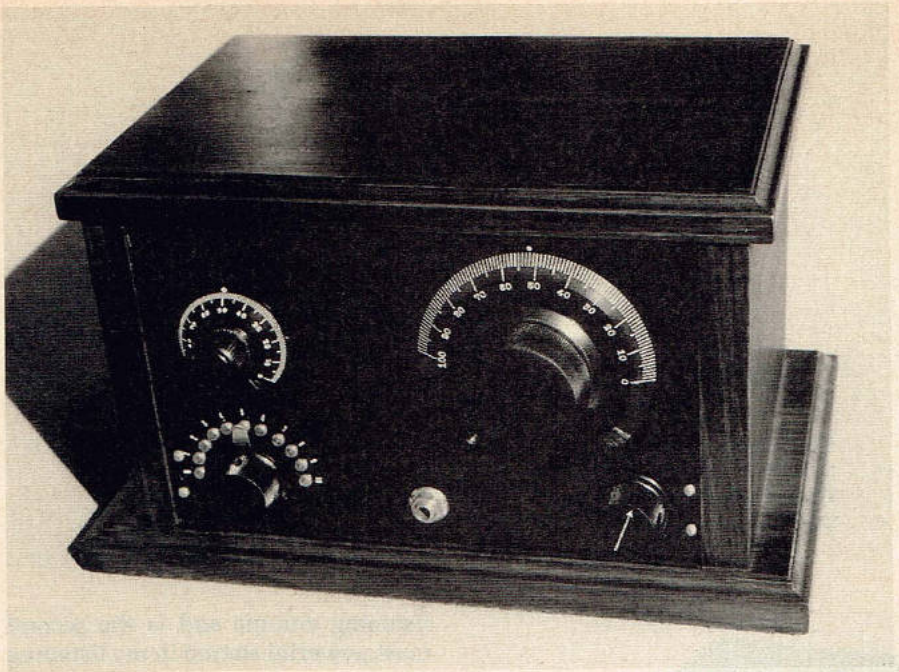
Now when a parallel tuned wave-trap is used with a crystal set and is tuned to reject 3CV, there are two noticeable effects. First, it is so effective it blocks out 3CV as though it doesn't exist. Second, it broadens the tuning of 3WV to such an extent it can be heard over the entire range of the dial. When trying to tune in 3WV, the tuning never peaks on the station. It's everywhere but nowhere in particular.

In this case, the wave-trap not only filters out 3CV, it also disrupts the receiver's tuning circuitry. As far as crystal sets are concerned, a parallel tuned trap is much too severe and a more compatible trap is required.

Simple regenerative receives do not perform that well on a parallel tuned trap either. The trap is effective as far as controlling the local station is concerned but there is a tendency to block out a sizeable band of frequencies on either side of the resonant frequency. So this type of trap is by no means suitable for use with all vintage receivers.

Tapping the coil

The trap shown in Fig.2 is a variation of the parallel tuned trap and incorporates a tapped coil. By tapping the aerial into the coil at different connection points, the effectiveness of the trap can be altered. Perhaps the best setup would be to have a sliding contact so that the aerial can be connected to any part of the coil.



A tuned secondary wave-trap with a 6-turn primary is the ideal wave-trap for the author's crystal set (shown here) and the prevailing reception conditions.

Although I have never used this type of trap, it seems to have very good possibilities.

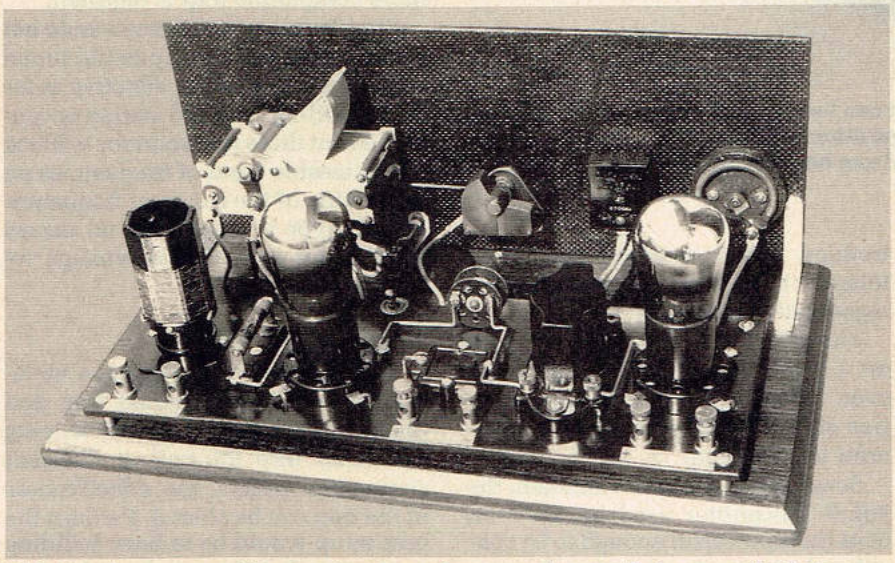
Tuned-secondary wave-trap

At this stage of our story it is time to discuss the third type of trap. This is known as the tuned secondary wave-trap and is shown in Fig.3.

There are some significant differences between this design and the previous ones. The most obvious is that there are now two windings and the tuned section is inductively coupled to the primary through which the aerial is connected.

In this design, the effectiveness of the trap depends to a large extent on the number of turns on the primary. These turns are wound directly over the secondary winding and the greater the number of primary turns, the more effective the trap.

Experiments with crystal sets have indicated that about six turns on the primary winding are just about right for my reception conditions (and for the type of crystal set being used).



This 2-valve regenerative receiver's performance is greatly improved when using a secondary tuned wave-trap with a 24-turn primary.

And with so few turns, there are no adverse effects. No longer is 3WV spread across the entire dial, nor is there a void near the resonant frequency as previously mentioned.

The tuned secondary trap only moderately suppresses 3CV and allows sufficient signal to pass through to enable the station to be heard at a normal listening level. Without the trap, the headphones are too loud for comfortable listening and when they are laying on the bench they can be heard "barking" away from anywhere in the room.

However, a 6-turn primary is not sufficient for a 1-valve regenerative receiver as the local station is still quite unrestrained and swamps half the tuning range. Instead, simple regenerative receivers seem to work better with about 20 or more turns on the primary. Even then, 3CV is still fairly broad in its tuning but it is not a bad compromise considering the type of receiver and the close proximity of the station.

A point worth mentioning is the fact that two secondary tuned wave-traps can be used in series to trap out two strong local stations without greatly affecting the signal strengths of other stations.

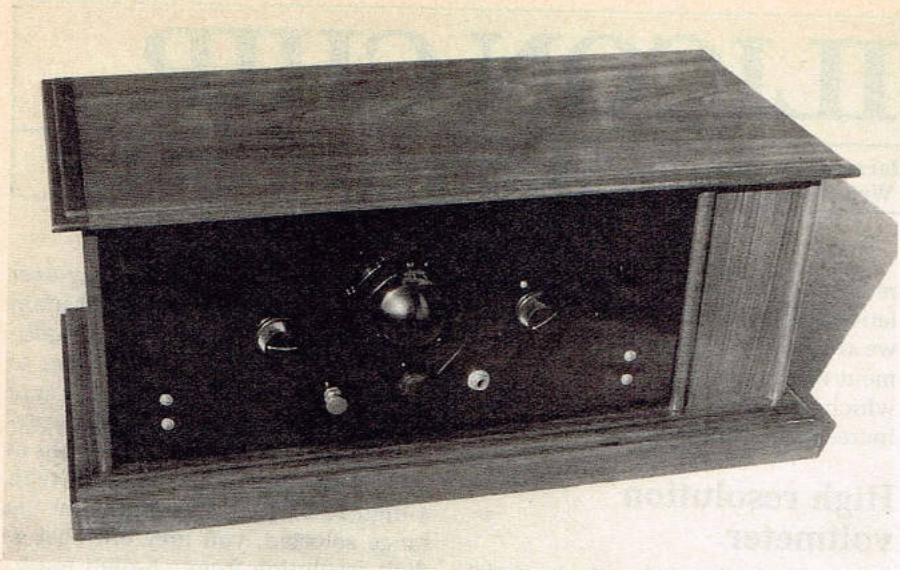
The super wave-trap

Each type of vintage radio requires its own special wave-trap setup. This could lead to a situation where one has half a dozen or so different traps in order to obtain optimum results from a number of receivers.

To remedy this situation, the "Super Wave-Trap" has been built. The Super Wave-Trap incorporates the best of both designs and can be changed from parallel-tuned to secondary-tuned at the flick of a switch. In addition, when switched to secondary mode, the tapped primary can be switched from six to 24 turns in increments of six turns at a time.

Wiring up the trap was a bit of a nightmare and two switches (a rotary and a double-throw multi-pole) were used to sort out the problem.

Now some experts may suggest that, in theory, the last thing a low-performance receiver such as a crystal set needs in its aerial system is a network of tapped coils and switches. The theory is that RF currents are impeded by such things and, therefore, the Super Wave-Trap may defeat its own



1920s receivers such as the "three-valver" lack selectivity and are easily overpowered by local transmissions. A wave-trap can help overcome this problem.

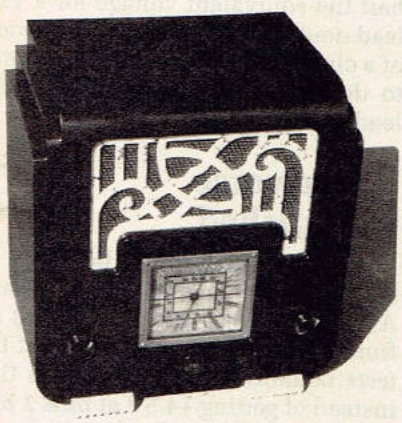
purpose by having too much high-frequency impedance.

This theory did not hold up in practice and while there might be losses, in practice they are too small to detect. The advantage of using the trap far outweighs any disadvantages.

The Super Wave-Trap has what some may consider an odd addition – an earth terminal. It's not that a trap actually needs one but it can be convenient to have both aerial and earth leads coming from the same part of the bench. The earth lead simply passes through the cabinet of the trap. While such a setup is unnecessary, it's OK as far as I'm concerned.

Talking about earth leads, it is a good idea to use an earth on any receiver that's connected to a wave-trap. Although the trap works without the receiver being earthed, it seems to be more effective if it is.

In a very strong local signal area, the lead from the wave-trap to the receiver's aerial terminal should be as short as possible. If living under the shadow of a transmission tower, a long lead from the trap to the aerial terminal will only pick up unwanted RF signal. If the lead has to be long, it's advisable to use coaxial cable to make the connection.



Even superhets can have some minor problems with nearby transmitters and, in some cases, a wave-trap can be of assistance. Shown is a dual-wave AWA Radiolette.

Crystal set DX'ing

Back in my boyhood days, the term "wave-trap" meant nothing to me. Yet, if I had known then what I know now, my crystal set listening may not have been restricted to one station.

DX'ing with a crystal set is a lot more practical today than it ever was in the past. Transmitters operate at much higher wattages now and effective crystal set range has increased accordingly. But although increased power can be an advantage, it can also be a disadvantage if a powerful transmitter is in your neighbourhood.

Simple regenerative receivers and crystal sets, in particular, benefit from such a device because these receivers lack selectivity. A wave-trap helps to reject the stronger signals these simple receivers cannot cope with. If you are having reception problems due to a nearby transmitter, then a wave-trap may help solve or at least reduce your problem. **SC**

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Got a technical problem? Can't understand a piece of jargon or some technical principle? Drop us a line and we'll answer your question. Write to: Ask Silicon Chip, PO Box 139, Collaroy Beach, NSW 2097.

Drill speed controller has insufficient range

I purchased the Drill Speed Controller on the advice that this unit would give a full 235-240VAC output when in the maximum position. I have assembled the kit only to see that the output (measured under load using a DVM) reads 128V when using with a drill, yet it varies beautifully to very low and no internal adjustment will change this. Of course, the drill is noticeably slower but has plenty of torque. Can you please tell me if this is the normal characteristic for this kit? (J. C., Rydalmere, NSW).

• Your drill speed controller is working exactly as it should.

Since they effectively half-wave rectify the 240VAC mains sine waveform, by virtue of their use of an SCR (silicon controlled rectifier) or in this case, a Triac which triggers only on positive half-waves, the maximum voltage output is reduced to about 160V RMS. As you have found, this leads to a significant reduction in maximum speed of your drill.

It is not possible to design an SCR or Triac speed control to give full speed range and still have good speed regulation and low-down torque. However, we are presently doing some development work on a Mosfet speed control which we hope will have a greatly increased output range.

High resolution voltmeter

I want to build a voltmeter to read 0 to 5V DC but with a better resolution than a typical 4½-digit LCD and I want to use LED displays. I see you published a circuit in June 1993 for a car voltmeter but it does not have the resolution required.

I also need a peak-hold function. I want to hold the highest reading for two minutes so I can write it down. Can you help? (L. S., Sydney, NSW).

• We do not have such a circuit on file and it is our opinion that because of the very high accuracy required, typically around .02%, such a project is beyond the scope of a magazine article.

From your requirements it appears as though you need a 5-digit benchtop instrument. Such instruments are made by Fluke, Blackstar and Thurlby-Thandar. You can expect to pay over $1000. Alternatively, you could adapt a standard 4000-count digital multimeter and use a fixed DC offset to improve upon the basic resolution of your readings. For example by applying a precise 3V offset, you could at least measure your 5V readings with 4-digit resolution. Depending on the range selected, you may only get 4-digit resolution from a 5-digit multimeter in any case.

6V regulator for cars

I am interested in trying to adapt the circuit shown on page 97 of your publication "20 Electronic Projects For Cars". It is for an automotive voltage regulator. I would like to adapt this to work from a generator rather than an alternator for a 6V system as used in classic English motorcycles. The electro-mechanical regulator normally used provides around 8.5V at up to 6 amps to charge the battery. Any help you could give me would be greatly appreciated. (J. W., North Balwyn, Vic).

• It should be possible to adapt your enclosed circuit by simply changing the zener diode from 12.8V to around 5.6V so that the regulator cuts out at a charging voltage of around 7.7V; ie, half the equivalent voltage for a 12V lead-acid battery. We would be wary of a circuit that allowed the generator to deliver 8.5V because that would lead to overcharging of the battery.

Vader voice vanquished

Recently I built the Vader Voice, as shown in your September 1995 issue. At the moment, I get no sound at all from the unit and while most of the tests come out correctly, I find that instead of getting +4.5V at pins 2 & 5, of IC1 and pins 1 & 2 of IC2, I am only getting readings of +1V.

Are you able to make any suggestions as to the source of my problem? I have double checked the position-

Interference problem with car antenna

I am experiencing AM interference with the Car Antenna Adaptor featured in the December 1988 issue of SILICON CHIP.

It appears that the interference problem relates to overhead power lines as the interference increases in relation to the proximity and number of power lines. No nearby power lines, no interference. The adaptor setup picks up very much more interference than the original, conventional antenna.

Is there anything I can do to stop this interference? I have tried running the 75Ω coaxial cable to within two to four inches (50 to 100mm) of the actual rear window demister, the closest I could get without perhaps damaging the demister terminals. (P. P., Klemzig, SA).

• Unfortunately, there is no way of eliminating this problem with the Car Antenna Adaptor. The problem may well be worse than with the original antenna since the main axis of the antenna is horizontal. In fact, the only way of effectively eliminating or reducing interference from power lines is to use a large loop antenna. This is very effective in a fixed installation but is clearly not practical at all in a car.

ing, polarity and correctness of all components, and replaced ICs 1 & 2 but still have 1V at these positions. (B. M., Wellington, NZ).

• The fact that points which should measure +4.5V have only 1V present suggests that the voltage divider consisting of two 220kΩ resistors includes a resistor with the wrong value or the associated 10µF capacitor is the wrong way around. Our bet is that one of the resistors is 27kΩ instead of 220kΩ. We assume that your 9V battery is fresh and is delivering 9V.

Query on TV sound

Can you please tell me if the TV stereo sound format is the same used for FM broadcasting apart from the different deviation and perhaps different pre-emphasis? I am wondering if the same stereo decoder chips can be used. (P. C., Glenhuntly, Vic).

• While both FM radio and TV sound are frequency modulation systems, their deviation and de-emphasis are different. However the major difference is in how the stereo channels are encoded. FM radio uses a multiplex method with the modulation switched between left and right channels at a rate of 38kHz. By contrast, stereo TV uses two separate subcarrier frequencies, at 5.5MHz and 5.742MHz above the vision carrier.

Hence, the methods of decoding stereo TV are quite different from FM multiplex stereo and different IC decoders are required.

TV pattern generator programming

I have purchased your new Colour Television Pattern Generator and wonder if you could explain the addressing of the EPROM (IC1) via the four 74HC193 counters. It appears unusual and I wonder if it makes programming easier. The least significant bit of the counter is connected to A1 on the EPROM but the most significant bit goes to A10 instead of A15. Is the software available now from SILICON CHIP? (C. M., Salisbury, SA).

• This project used unusual addressing to the EPROM to simplify the PC board design. Since the EPROM would be programmed and run with the same addresses then it is not important which order the address lines are accessed as long as it is consistent. After all, the address labelling on the EPROM is only arbitrary anyway.

The software is available from SILICON CHIP for $10.00, including postage and packing.

When do you change the filter?

I have a water purifier but I never know when to change the filter. Can you design a project to detect when the filter needs changing? (D. S., Miller, NSW).

• Unless the conductivity of the filtered water changes over time, as the filter deteriorates, we cannot think of any electronic method which could tell you when to change the filter. Perhaps one of our readers can suggest a method.

Amplifier module needs DC-DC inverter

I am enquiring about details of the 50W amplifier module described in the March 1994 issue of SILICON CHIP. The kit runs on 25VAC and I was wondering if the circuit can be changed so that the amplifier can be run off a car battery with the same power output. Also, I was wondering how to change a stereo signal to a mono signal. Do you simply join the left and right channels to make one channel? (N. B, Gladesville, NSW).

• In order to deliver the full 50W, this module needs a DC supply rail of ±35V or 70V in total. If it was to be run directly from 12V DC, the power output would be less than 4W into a 4Ω loudspeaker. The only way to get the full power would be to use a DC-DC inverter. We published a suitable project along these lines in the December 1990 issue.

Guitar/PA amplifier wanted

I wish to obtain information on the building of a guitar/PA amplifier. I have long been impressed with the tonal reproduction of valve amplifiers. My requirement is an amplifier with a 100W capacity and some (or all) of the features of the Fender amps of the 60s era (reverb, echo, etc). I would most appreciate any advice you can offer me with regard to circuit diagrams, sources of supply of valves, power transformers, audio transformers and speaker enclosure dimensions. (J. S., Isle of Capri, Qld).

• We have not published any circuits for valve power amplifiers and nor do we think they are a practical or economic alternative to a well-designed solid state amplifier. For a high performance guitar/PA amplifier, we strongly suggest the 175W module presented in the March 1997 issue of SILICON CHIP. You might also consider building the Digital Effects Unit published in the February 1995 issue, to provide effects such as reverberation, echo, vibrato, etc.

Notes & Errata

Colour TV Pattern Generator, June & July 1997: the patterns produced by the TV Pattern Generator are slightly off-centre on the TV screen due to a slight displacement in the line sync signal. In most cases, the normal overscanning of each line on the TV screen will mask out this small shift.

It can be corrected by adding an RC network to delay the line sync by the requisite 1.5µs. This involves adding a 4.7kΩ resistor between the D7 output of IC1 at pin 11 and the sync input of IC10 at pin 16. The pin 16 input of IC10 is bypassed to ground with a 270pF capacitor.

The resistor is best placed instead of the link on the PC board above the three 330Ω resistors near IC10. Note that IC10 has an incorrect pin 1 labelling on the PC board. The position shown for pin 1 is actually pin 16. The capacitor can connect from pin 16 to pin 1 of IC10 on the underside of the PC board.

Flexible Interface Card For PCs; July, 1997: there are two errors in the Basic listing shown on page 28. Line 90 should read: B$ = RIGHT$(TIME$,2): WHILE RIGHT$(TIME$,2) = B$: WEND 'wait one second. Line 220 should read: LOCATE 24,20: PRINT "Line";LIN; 'print it. Note: do not put full stops at the ends of the lines. **SC**

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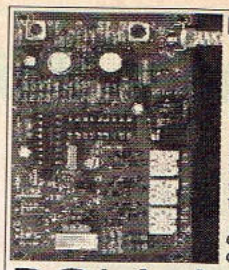

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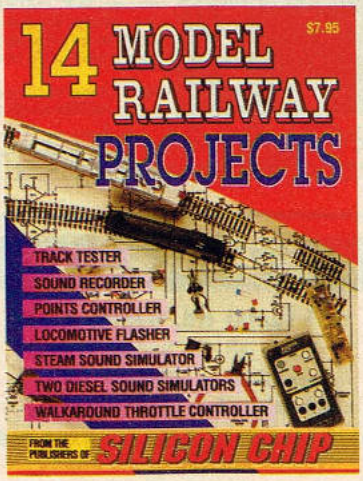

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